22-08-2005

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION See Form PCT/IPEA/416	
IP20041228MC		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NO2004/000146	14.05.2004	15.05.2003
International Patent Classification (IPC) or national classification and IPC		
E21B 19/06		
Applicant		
Mechlift AS et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 49 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s))
      _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☒ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17.01.2005	10.08.2005
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Form PCT/IPEA/409 (cover sheet) (April 2005)

CORRECTED

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/NO2004/000146

Box No. I Basis of the report

1. With regard to the language, this report is based on:

☐ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of:

☐ international search (Rules 12.3(a) and 23.1(b))

☐ publication of the international application (Rule 12.4(a))

☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

☐ the international application as originally filed/furnished

☒ the description:

pages 1-37 as originally filed/furnished

pages* _____ received by this Authority on _____

pages* _____ received by this Authority on _____

☒ the claims:

pages _____ as originally filed/furnished

pages* _____ as amended (together with any statement) under Article 19

pages* 38-60 received by this Authority on 04.07.2005

pages* _____ received by this Authority on _____

☒ the drawings:

pages _____ as originally filed/furnished

pages* 1-26 received by this Authority on 04.07.2005

pages* _____ received by this Authority on _____

☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing *(specify)*: _____

☐ any table(s) related to the sequence listing *(specify)*: _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/figs _____

☐ the sequence listing *(specify)*: _____

☐ any table(s) related to the sequence listing *(specify)*: _____

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/NO2004/000146

Box No. IV Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has, within the applicable time limit:

   ☒ restricted the claims

   ☐ paid additional fees

   ☐ paid additional fees under protest and, where applicable, the protest fee

   ☐ paid additional fees under protest but the applicable protest fee was not paid

   ☐ neither restricted the claims nor paid additional fees

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is:

   ☒ complied with

   ☐ not complied with for the following reasons:

4. Consequently, this report has been established in respect of the following parts of the international application:

   ☒ all parts

   ☐ the parts relating to claims Nos. _____

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/NO2004/000146

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-87	YES
	Claims		NO
Inventive step (IS)	Claims	1-87	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-87	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Documents cited in the International Search Report:

D1: US3278220 A
D2: US3265431 A
D3: EP1099824 A2
D4: WO9911902 A1
D5: US3857450 A

In view of the amended claims, the cited documents represent the general state of the art.

The invention defined in claims 1-87 is not disclosed by any of these documents.

The cited prior art does not give any indication that would lead a person skilled in the art to the claimed lifting tool and system for handling pipe-strings and pipe sections or to the claimed method for lifting pipe-sections. Therefore, the claimed invention is not obvious to a person skilled in the art.

Accordingly, the invention defined in claims 1- 87 is novel and is considered to involve an inventive step.

The invention is industrially applicable.

AMENDED CLAIMS

1. A lifting tool for handling of a pipe-string (2) and pipe sections (3,4) during joining and lowering or lifting and disassembly of conductors, casings, risers, drill strings or similar in a bore hole (160) or a well (161), the lifting tool comprising

- a lifting part (20) comprising a coaxial, rod (47) and a connection part (5) for connection to and receiving lifting force from a drive unit or top drive (60) or derrick crane (60); and
- a hydraulic system (40) arranged for retaining and holding the lifting part (20) against either or both of the outer or inner surface of an end of the pipe sections (3,4) or the pipe string (2);
- a lifting nipple (32) with a hollow coaxial lifting nipple axle (36), a lifting nipple cone (37), and a lifting nipple flange or collar (33) which is located between the lifting nipple axle (36) and the lifting nipple cone (37) and further arranged for transfer of load to the lifting tool, in which the lifting nipple (32) is arranged concentric about the piston rod (47) and arranged for movement along the piston rod (47), in which the lifting nipple (32) is arranged for carrying the entire or part of the weight of the pipe section (3,4) or the resulting pipe-string (2), and in which the lifting nipple cone (37) is provided with external generally horizontal grooves or external central threads (34) and arranged for screwing into and out of the end of a pipe section (3,4), characterized in
- that the lifting part (20) is arranged for rotation about the central axis of the piston rod (47), such that the lifting part (20) with the pipe section (3,4) is arranged for a controlled joining of the pipe section (3,4) with a generally upright pipe section or pipe string (2) located below. preferably joining by screwing the pipe section (3,4) into the end of the pipe section or pipe string (2);
- that the lifting part (20) after the joining of the pipe section (3,4) with the pipe string (2) is arranged for supporting the entire or part of the weight of the resulting pipe string (2); and
- that the lifting part (20) is pivotable about a horizontal axis and arranged for grasping a pipe section (3,4) from a generally horizontal or nearly horizontal position.

2. A lifting tool according to claim 1, in which the lifting part (20) is arranged for circulation of drilling fluid, drilling mud, cement or other fluid or fluid mixture via a flexible hose (7) on the connection part (5) of the lifting tool and via the piston rod (47) in the lifting part (20) of the lifting tool.

3. A lifting tool according to claim 1, in which the lifting part (20) also comprises a coaxial guide tube (38) arranged concentric about the piston rod (47).

4. A lifting tool according to claim 3, in which the lifting nipple (32) is arranged concentric about the coaxial guide tube (38), and in which the lifting nipple (32) is arranged for movement along the coaxial guide tube (38) during screwing into and screwing out of the pipe section (3,4).

5. A lifting tool according to claim 3 or claim 4, in which external threads (38a) are arranged on the coaxial guide tube (38) for engagement with internal, generally horizontal grooves or threads (35) on the lifting nipple (32).

6. A lifting tool according to claim 1, in which the lifting part (20) further comprises a housing (16) with a top plate unit (17) or a top plate (21), and in which the housing (16) comprises a main lifting shoulder (18) and a base plate (19).

7. A lifting tool according to claim 6, in which the top plate unit (17) comprises

- at least one, preferably two disc shaped plates (17a,b), each with a central opening,
- one or more web sections (17c) arranged for stiffening the top plate unit (17) and oriented generally normal to and between the top plates (17a,b), and in which the web sections (17c) are fixed to the top plates (17a,b) preferably by a welded connection;

- a mounting plate (149) arranged on an outside of the upper plate (17a); and
- a self lubricating bushing arranged between a lifting collar (48) on the piston rod (47) and the other top plate (17b).

8. A lifting tool according to claim 1, in which the lifting part (20) further comprises a nipple rotation system (90) arranged for screwing into and screwing out of the lifting nipple cone (37) of the lifting nipple (32) in a threaded portion of an end of the pipe section (3,4) to be lifted or loosened.

9. A lifting tool according to claim 8, in which the nipple rotation system (90) comprises one or more hydraulic motors (91), each provided with a gear sprocket (93) on a gear axle (94).

10. A lifting tool according to claim 8 or claim 9, in which the top plate unit (17) comprises a cylinder (17d) with a spindle system (17e) for inlet (95), outlet (96) and case drain (97) passages for hydraulic oil connection to the nipple rotation system (90), in which the cylinder (17d) is arranged concentric about the piston rod (47) and axially centered in the top plates (17a,b).

11. A lifting tool according to claim 5 or 6, in which the lifting nipple axle (36) of the lifting nipple (32) is provided with external vertical grooves or splines (36a) and arranged for engagement by and for being rotated by one or more gear sprockets (93) in the nipple rotation system (90).

12. A lifting tool according to claim 1, in which the lifting part (20) also comprises
- an adapter (6) which is connected to a high pressure hose (7) with a swivel (7a) by means of a union (7a), for application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture from the drive unit or top drive (60),

- a bolted goose-neck connection (8), preferably with a swivel, for conveying drilling fluid, drilling mud, cement, or other fluid or fluid mix to the piston rod (47) in the lifting part (20), connected to a manifold or wear adapter (9) for venting of air during application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture from the drive unit or top drive (60).

13. A lifting tool according to claim 1, in which the lifting part (20) is pivotably arranged in an elevator apparatus (70) which is arranged about the piston rod (47), preferably in a recess or lifting shoulder (13) on the piston rod (47).

14. A lifting tool according to claim 1, in which the lifting part (20) further comprises a tilting arm (10) with one end (10a) arranged concentric about the piston rod (47), and the other end (10b) is connected to a telescopic hydraulic lifting cylinder (61), preferably by means of a chain connection or other suitable attachment means.

15. A lifting tool according to claim 1, in which the lifting part (20) comprises

- an entry cone or expanding packing or mud packer (140), preferably an elastomer packing (140), arranged concentric about the piston rod (47), and arranged for entry in one end of the pipe section (3,4) or pipe string (2) and for expansion against the inner surface of the pipe section (3,4) or pipe-string (2) upon activation of the lifting tool, in which the entry cone (140) is attached to the piston rod (47) by means of a bolted connection (143,144); and
- a funnel shaped entry guide (141) with a compliant support ring (146), in which the entry guide (141) is arranged for receiving and encompassing the end of the pipe section or pipe string (2,3,4), and to contact and clamp against the external surface of the pipe section or pipe string (2,3,4).

16. A lifting tool according to claim 1, in which the piston rod (47) comprises a hollow fluid passage (147) for application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture and a hollow fluid passage (148) for venting of air during application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture.

17. A lifting tool according to claim 1, in which the hydraulic system (40) is a double acting or bi-directional piston cylinder mechanism which includes a hydraulic cylinder (42) with a piston cylinder base (44), a piston cylinder plate (41) and a hydraulic piston (43) which is arranged concentric about and fixed to the axial piston rod (47).

18. A lifting tool according to claim 17, in which the hydraulic system (40) also comprises:

- an inlet fluid passage (51) for hydraulic oil connection to one side of the hydraulic piston (43) in the hydraulic cylinder (42); and
- an outlet fluid passage (52) for hydraulic oil connection to the other side of the hydraulic piston (43) in the hydraulic cylinder (42);
- in which the inlet passage (51) and the outlet passage (52) run through the piston rod (47) from the manifold (9).

19. A lifting tool according to claim 1, in which the lifting part (20) of the lifting tool comprises a wedge system which is arranged for grasping and holding the pipe section or pipe string (2,3,4) to be lifted, and in which the wedge system includes at least one set of opposing outer (24) and inner (29) wedge segments or wedge rings, preferably with a sealing segment or sealing ring (29a) arranged on one side of the wedge ring or wedge segment (29) facing the external surface of the pipe section or pipe string (2,3,4), and where the inner surface of the pipe section or pipe string (2,3,4) is engaged by the entry cone (140).

20. A lifting tool according to claim 1, in which the lifting part (20) further comprises a coaxial bearing cylinder (22) with a top plate (22a) and a guide or stop plate (22b), where the coaxial bearing cylinder (22) is arranged for guiding the lifting nipple (32) into the correct position during screwing into the pipe section (3,4).

21. A lifting tool according to claim 20, in which the main lifting shoulder (18) is arranged for postioning adjacent to the guide or stop plate (22b) when the lifting tool is activated, and in which the guide or stop plate (22b) is arranged for positioning adjacent to the lifting nipple flange or collar (33) when the lifting nipple (32) is screwed into the threaded section of one end of the pipe section (3,4).

22. A lifting tool according to claim 20, in which the nipple rotation system (90) is attached to the coaxial bearing cylinder (22) by means of one or more mounting brackets (92).

23. A lifting tool according to claims 3-5, in which the coaxial bearing cylinder (38) is connected to a spring system (39) for compensating and equalizing the tension forces between the external horizontal grooves or threads (34) of the lifting nipple cone (37) and internal horizontal grooves or threads (3a) in one end of the pipe section (3,4), and between the internal horizontal grooves or threads (34) of the lifting nipple (32) and the external horizontal grooves or threads (38a) on the coaxial bearing cylinder (38).

24. A lifting tool according to claim 22, in which the spring system (39) comprises two or more helical springs (38) or helical collar (38).

25. A lifting tool according to claim 23-24, in which the hydraulic cylinder (42) with the piston cylinder base (44) is attached to one side of the top plate (22a) bearing cylinder (22), and in which the spring system (39) with the coaxial guide tube (37) is attached to the top plate (22a) of the coaxial bearing cylinder (22) on the opposite side of the hydraulic cylinder (43) and piston cylinder base (44).

26. A lifting tool according to claim 1, where one or more independent sensors (15) is arranged in the lifting part (20) of the lifting tool, preferably spring loaded pressure sensors, to determine the position of the lifting nipple (32) with respect to the end of the pipe section (3,4), and where each sensor (15) is connected to a limit switch (14).

27. A lifting tool according to claim 6 or 7, where the housing (16) comprises one or more inspection openings.

28. A lifting tool according to anyone of the preceding claims, in which one or more lugs are arranged on the lifting nipple flange (33) of the lifting nipple (32), for manual operation of the lifting nipple (32), preferably with the use of a lever or crow-bar.

29. A lifting tool according to claim 17, in which hydraulic oil is supplied by a preferably radial inlet (50) on the support part (5) and via a generally vertical passage (51) for hydraulic oil through the piston rod (47) and with a radial outlet for hydraulic oil from the piston rod (47) under the piston (43) to move the piston (43) upwards.

30. A lifting tool according to claim 29, in which hydraulic oil is supplied from the upper part of the hydraulic cylinder (42) above the piston (43) to drive the inner wedge rings (29) downward such that the outer wedge segments (24) with friction surface (27) retract from and release the inner wall of the pipe section or pipe string (2,3,4).

31. A lifting tool according to claim 1, in which the piston rod (47) comprises
- a fluid passage (147) arranged for application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture, and
- a fluid passage (148) configured for venting of air during application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture.

32. A lifting tool according to claim 1, in which the piston rod (47) comprises a lifting collar (48) arranged for transfer of load from the piston rod (47) of the lifting tool to the lifting part (20) of the lifting tool.

33. A lifting tool according to claim 14, in which lifting part (20) of the lifting tool comprises a locking mechanism for the lifting tool,

- in which a slotted hub (5a) is arranged concentric about and attached to the piston rod (47), and in which the tilting arm (10) is compliant, preferably with a spring loaded joint (10a) in the tilting arm (10), and
- where the compliant tilting arm (10, 10a) is arranged for movement from an initial position and passively downwards into one of the slots in the slotted hub (5a) to an operating position, for locking of the entire lifting tool against rotation of the lifting part (20) of the lifting tool.

34. A lifting tool according to claim 33, where the spring loaded joint (10a) is arranged for release of the tilting arm (10) upon retraction of the spring loaded joint (10a) from a position where the lifting part (20) of the lifting tool has been rotated from the initial position and back to the initial position.

35. A lifting tool for handling of a pipe string (2) and pipe sections (3,4) during joining and lowering or raising and disassembling of conductors, casings, risers, drilling strings or similar in a bore hole (160) or well (161), in which the lifting tool comprises

- a lifting part (20) which comprises an axial piston rod (47) arranged through, and a connection part (5) for connection to and receiving lifting force from a drive unit or top drive (60) or derrick crane (60); and
- a hydraulic system (40) which is arranged for retaining and holding the lifting part (20) against the inner surface of an end of the pipe section (3,4) or pipe string (2);

- a wedge system with inner wedge segments or inner wedge rings (29) attached to the piston rod (47), in which the inner wedge segments or wedge rings (29) are arranged for movement in an axial direction inwards under ramped surfaces of the outer wedge segments (24) and thereby press the outer wedge ring segments radially outward,

characterized in

- that the outer wedge segments are provided with a radially oriented friction surface (27) to engage the inner surface of the pipe section (2,3,4),
- that the outer clamping ring-segments (24) is arranged for being forced directly or indirectly downwards by a top plate (21) with a hydraulic cylinder (42) connected to the top plate (21), the hydraulic piston (43) of the cylinder (42) being attached to the piston rod (47), which is arranged for forcing the inner wedge rings (29) upwards in relation to the outer wedge segments (24) and thereby expands the friction surface (27) outwards to grip the inner diameter of the casing (2),
- that the lifting part (20) is arranged for rotation axially about the piston rod (47), such that the lifting part (20) with the pipe section (3,4) is arranged for a controlled joining of the pipe section (3,4) with the a generally upright pipe section or pipe string (2) located below, preferably joining by screwing into the pipe section (3,4) into a the pipe section or pipe string (2),
- that the lifting part (20) after the joining of the pipe section (3,4) with the pipe string (2) is arranged for supporting the entire or part of the weight of the resulting pipe string (2), and
- the lifting part (20) is pivotable about a horizontal axis and arranged for grasping a pipe section (3,4) from a generally horizontal or nearly horizontal position.

36. A lifting tool according to claim 35, where the inner wedge rings (29) are attached to the piston rod (47) via a coaxial bearing cylinder (22), which itself is attached to a coaxial base plate (39), and which in turn is attached to the piston rod (47) with a lower intermediate piece (48) and locked by a hex nut (143,144).

37. A lifting tool according to claim 35, where the outer wedge segments (24) and inner wedge rings (29) of the lifting part (20) are arranged in pairs in several levels between the base plate (30) and top plate (21).

38. A lifting tool according to claim 37, where outer wedge segments (24) of the lifting part (20) are separated in the axial direction by spacer rings (26).

39. A lifting tool according to claim 35, where the hydraulic system (40) is a double acting or bidirectional piston cylinder mechanism which includes a hydraulic cylinder (42) with a piston cylinder base (44), a piston cylinder plate (41) and a hydraulic piston (43) which is arranged concentric about and attached to the axial piston rod (47).

40. A lifting tool according to claim 39, in which hydraulic oil is supplied via a preferably radial inlet (50) on the connection part (5) and via a generally vertical passage (51) for hydraulic oil through the piston rod (47) and further including a radial outlet for hydraulic oil from the piston rod (47) under the piston (43) for activating the the piston (43) to move upwards.

41. A lifting tool according to claim 40, in which hydraulic oil is supplied from the upper portion above the piston (43) to the hydraulic cylinder (42) so as to drive the outer wedge rings (24) downward such that the inner wedge segments (29) with packing or packing ring (29a) retract from and release the inner wall of the pipe section or pipe string (2,3,4).

42. A lifting tool according to claim 35, in which the lifting part (20) is arranged for circulation of drilling fluid, drilling mud, cement or other fluid or fluid mixture via a flexible hose (7) on connection part (5) of the lifting tool and via the piston rod (47) in the lifting part (20) of the lifting tool.

43. A lifting tool according to claim 35, in which the lifting part (20) further comprises

- an adapter (6) which is connected to a high pressure hose (7) with a union (7a), for application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture from a drive unit or top drive (60), and
- a bolted goose neck connection (8), preferably with a swivel, for application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture to the piston rod (47) in the lifting part (20), connected to a manifold or wear adapter (9) for venting of air during application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture from the drive unit or top drive (60).

44. A lifting tool according to claim 35, in which the lifting part (20) is pivotably arranged in an elevator apparatus (70) arranged about the piston rod (47), preferably in a recess or lifting shoulder (13) on the piston rod (47).

45. A lifting tool according to claim 35, in which the lifting part (20) further comprises a tilting arm (10) with one end (10a) arranged concentric about the piston rod (47), and the other end (10b) is connected to a telescopic hydraulic lifting cylinder (61), preferably by means of of a chain connection or other suitable attachment means.

46. A lifting tool according to claim 35, where the lifting part (20) comprises an entry cone or expanding packing or mud packer (140), preferably an elastomer packing (140), arranged concentric about the piston rod (47), arranged for entry in one end of the pipe section (3,4) or pipe string (2) and for expansion against the inner surface of the pipe section (3,4) or pipe string (2) upon activation of the lifting tool, where the entry cone (140) is attached to the piston rod (47) by means of a bolted connection (143,144).

47. A lifting tool according to claim 35, in which the piston rod (47) comprises

- a fluid passage (147) arranged for application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture, and
- a fluid passage (148) arranged for venting of air during application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture.

48. A lifting tool according to claim 35, in which the lifting part (20) of the lifting tool further comprises an indicator system arranged for one or more independent sensors (15) in the lifting part (20) of the lifting tool, preferably spring loaded pressure sensors, for determining position of the entry cone (140) with respect to the end of the pipe section (3,4), and where each sensor (15) is connected to a limit switch (14).

49. A lifting tool according to claim 45, in which the lifting part (20) of the lifting tool comprises a locking mechanism for the lifting tool,

- in which a slotted hub (5a) is arranged concentric about and attached to the piston rod (47), and in which the tilting arm (10) is compliant, preferably with a spring loaded joint (10a) in the tilting arm (10),
- in which the compliant tilting arm (10, 10a) is arranged for movement from an initial position and passively downwards into one of the slots in the slotted hub (5a) to an operating position, for locking of the entire lifting tool against rotation of the lifting part (20) of the lifting tool (20).

50. A lifting tool according to claim 49, in which the spring loaded joint (10a) is arranged for release of the tilting arm (10) upon retraction of the spring loaded joint (10a) from a position in which the lifting part (20) of the lifting tool has been rotated from an initial position and back to the initial position.

51. A lifting tool for handling of pipe strings and pipe sections (2,3,4) during joining and lowering or raising and disassembling of conductors, casings, risers, drilling strings or similar in a bore hole (160) or well (161), in which the lifting tool comprises

- a lifting part (20) comprising an axial piston rod (47), and a connection part (5) for connection to and receiving lifting force from a drive unit or top drive (60) or derrick crane (60);
- a hydraulic system (40) which is arranged for retaining the lifting part (20) against the outer surface of one end of the pipe section (3,4) or pipe string (2)
- a wedge system in the lifting part (20) of the lifting tool with one or more sets of inner wedge segments (29) and outer wedge segments or wedge rings (24), in which the lifting part (20) with the wedge system is arranged for grasping about the end of the pipe section (3,4) or pipe string (2) below the threaded section of the end of the pipe section (3,4) or pipe string (2); characterized in
- that the wedge system is arranged to be self locking such that the weight of the pipe section (3,4) or pipe string will act to increase the gripping and locking effect of the lifting force, thus ensuring secure gripping / locking in the event of the loss of hydraulic fluid pressure,
- that the lifting part (20) is arranged for rotation axially about the piston rod (47), such that the lifting part (20) with the pipe section (3,4) is arranged for a controlled joining of the pipe section (3,4) and a generally upright pipe section or pipe string (2) located below, preferably by screwing the pipe section (3,4) into the end of pipe section or pipe string (2),
- that the lifting part (20) after the joining of the pipe section (3,4) with the pipe section or pipe string (2) is arranged for supporting the entire or part of the weight of the resulting pipe string (2), and
- that the lifting part (20) is pivotable about a horizontal axis and arranged for grasping a pipe section (3,4) from a generally horizontal or nearly horizontal position.

52. A lifting tool according to claim 51, in which the lifting part (20) is arranged for circulation of drilling fluid, drilling mud, cement or other fluid or fluid mixture via a flexible hose (7) on the connection part (5) of the lifting tool and via the piston rod (47) in the lifting part (20) of the lifting tool.

53. A lifting tool according to claim 51, in which the hydraulic system (40) is a piston hydraulic system (40) having a hydraulic piston (43) connected to the piston rod (47) and arranged in a hydraulic cylinder (42), an in which the lifting part (20) of the lifting tool further includes

- an outer housing (16) with a top plate (21), and where the housing (16) comprises a lifting shoulder (18) and a base plate (19) with a central opening for a pipe section or pipe string (2,3,4) to be grasped;
- a coaxial bearing cylinder (22) with a guide or stop plate (22b), a bearing cylinder plate (22d) with a central opening, a center plate (22e) and an inner bearing cylinder (22f);
- in which the pressure under the piston (43) upon application of hydraulic fluid pressure forces the piston (43) with the piston rod (47) and the outer housing (16) upwards together with the base plate (19) of the outer housing (16) and the outer wedge segments or rings (24), such that the bearing cylinder (22) and the stop plate (22b) with the inner wedge segments (29) is forced downwards with respect to the outer wedge segments or rings (24) with the result that inner wedge segments (29) are forced inwards to engage and grasp the outer surface of pipe section (2,3,4).

54. A lifting tool according to claim 51, where the piston rod includes a lifting collar (48) arranged for transfer of load from the piston rod (47) of the lifting tool to the lifting part (20) of the lifting tool.

55. A lifting tool according to claim 53, where the outer housing (16) includes a top plate unit (17).

56. A lifting tool according to claim 55, in which the top plate unit (17) comprises

- at least one, preferably two disc shaped plates (17a,b), each with a central opening,
- one or more web sections (17c) arranged for stiffening the top plate unit (17) and oriented generally normal to and between the top plates (17a,b), and where the web sections (17c) are fixed to the top plates (17a,b) preferably by a welded connection;
- a mounting plate (149) arranged on an outside of the upper plate (17a); and
- a self lubricating bushing arranged between the lifting collar (48) on the piston rod (47) and the second top plate (17b).

57. A lifting tool according to claim 51, in which the lifting part (20) also comprises

- an adapter (6) which is connected to a high pressure hose (7) with a swivel (7a), for application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture from a drive unit or top drive (60),
- a bolted goose neck connection (8), preferably with a swivel, for application of drilling fluid, drilling mud, cement, or other fluid or fluid mix to the piston rod (47) in the lifting part (20), connected to a manifold or wear adapter (9) for venting of air during application of drilling fluid, drilling mud, cement, or other fluid or fluid mix from the drive unit or top drive (60).

58. A lifting tool according to 51, in which the lifting part (20) is pivotably arranged in an elevator apparatus (70) arranged about the piston rod (47), preferably in a recess or lifting shoulder (13) on the piston rod (47).

59. A lifting tool according to claim 51, in which the lifting part (20) further comprises a tilting arm (10) with one end (10a) arranged concentric about the piston rod (47), and the other end (10b) is connected with a telescopic hydraulic lifting cylinder (61), preferably by means of a chain connection or other suitable attachment means.

60. A lifting tool according to claim 51, in which the lifting part (20) comprises a funnel shaped entry guide (141) with a compliant support ring (146), in which the entry guide (141) is arranged for receiving and encompassing the end of the pipe section or pipe string (2,3,4) and to contact and clamp against the external surface of the pipe section or pipe string (2,3,4)

61. A lifting tool according to claim 51, where the piston rod (47) comprises
- a fluid passage (147) arranged for application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture, and
- a fluid passage (148) arranged for venting of air during application of drilling fluid, drilling mud, cement, or other fluid or fluid mixture.

62. A lifting tool according to claim 51, in which the hydraulic system (40) is a double acting or bidirectional piston cylinder mechanism which includes a hydraulic cylinder (42) with a piston cylinder base (44), a piston cylinder plate (41) and a hydraulic piston (43) which is arranged concentric about and attached to the axial piston rod (47).

63. A lifting tool according to claim 62, in which hydraulic oil is supplied by a preferably radial inlet (50) on the connection part (5) and via a generally vertical passage (51) for hydraulic oil through the piston rod (47) and with a radial outlet for hydraulic oil from the piston rod (47) under the piston (43) for activating the the piston (43) to move upwards.

64. A lifting tool according to claim 62, in which the hydraulic system (40) also comprises:

- an inlet fluid passage (51) for hydraulic oil to one side of the hydraulic piston (43) in the hydraulic cylinder (42); and
- an outlet fluid passage (52) for hydraulic oil to the other side of the hydraulic piston (43) in the hydraulic cylinder (42);
- in which the inlet passage (51) and the outlet passage (52) run through the piston rod (47) from the manifold (9).

65. A lifting tool according to claim 62, where hydraulic oil is supplied from the upper part of hydraulic cylinder (42) above the piston (43) to drive the outer wedge segments or rings (24) downward such that the inner wedge segments (29) with packing or packing ring (29a) retract from and release the inner suface of the of the pipe section or pipe string (2,3,4).

66. A lifting tool according to claim 51, in which the lifting part (20) of the lifting tool further comprises an indicator system arranged for one or more independent sensors (15) in the lifting part (20) of the lifting tool, preferably spring loaded pressure sensors, to determine position of the lifting part (20) with respect to the end of the pipe section (3,4), and where each sensor (15) is connected to a limit switch (14).

67. A lifting tool according to claim 59, where the lifting part (20) of the lifting tool comprises a locking mechanism for the lifting tool,

- in which a slotted hub (5a) is arranged concentric about and attached to the piston rod (47), and where the tilting arm (10) is compliant, preferably with a spring loaded joint (10a) in the tilting arm (10),
- in which the compliant tilting arm (10, 10a) is arranged for movement from an initial position and passively downwards into one of the slots in the slotted hub (5a) to an operating position, for locking of the lifting tool against rotation of the lifting part (20) of the lifting tool.

68. A lifting tool according to claim 51, in which the spring loaded joint (10a) is arranged for release of the tilting arm (10) upon retraction of the spring loaded joint (10a) from a position to which the lifting part (20) of the lifting tool (20) has been rotated from an initial position and back to the initial position.

69. A lifting system for lifting or lowering pipe section (3,4) and a pipe-string (2), during joining and lowering or lifting and disassembly of conductors, casings, risers, drill strings, or similar in a bore hole (160) or well (160), wherein the lifting system comprises

- a lifting tool with a lifting part (20) and a connection part (5) connected to an elevator apparatus (70) which is connected to a top drive (60) and in which the lifting part (20) of the lifting tool shall co-operate with a power slip (150) which is arranged for receiving and supporting a generally upright pipe section or pipe-string (2); characterized in
- that the lifting part (20) of the lifting tool is arranged for removable installation in an elevator apparatus (70);
- that the elevator apparatus (70) is arranged for controlling the orientation of lifting part (20) of the lifting tool such that the lifting tool may engage and grip the end of a pipe section (3,4) and be activated;
- that the elevator apparatus (70) and lifting tool upon application of lifting force to and activation of the lifting part (20) of the lifting tool are arranged to lift the lifting part (20) of the lifting tool (20) with the pipe section (3,4) for joining with or connecting to the generally upright pipe section or pipe-string (2) below; and
- the lifting part (20) of the lifting tool is arranged for being pivotable about a horizontal or generally horizontal axis in the elevator apparatus (70), so as to grasp an end of a pipe section (3,4) arranged in a generally horizontal or nearly horizontal position, and be engaged against the inner surface, the outer surface or both the inner and outer surface of one end of the pipe section (3,4).

70. A lifting system according to claim 69, wherein the lifting part (20) of the lifting tool is arranged for removable installation in the elevator apparatus (70) on an upper part or lifting shoulder (13) on a piston rod (47) included in the lifting tool (20).

71. A lifting system according to claim 69, wherein the lifting tool and the connection part (5) of the lifting tool (20) are arranged for application or circulation of drilling fluids, drilling mud, cement or other fluid or fluid mix to the bore hole or well (160).

72. A lifting system according to claim 69, wherein the lifting system further comprises a rotation apparatus (power tongs) (80) which is arranged for rotation of the lifting part (20) of the lifting tool (20) with the pipe section (3,4) about the piston rod (47), to achieve a controlled in-screwing of the pipe section (3,4) in the generally upright pipe section or pipe-string (2) located below, and in which the lifting part (20) of the lifting tool (20) after the joining of the pipe section (3) with the pipe-string (2) is arranged for to supporting the entire or part of the weight of the resulting pipe-string (2).

73. A lifting system according to claim 69, wherein the lifting tool is arranged for receiving lifting force from the top drive (60) for activating the lifting tool, such that the lifting tool after activation of the lifting part (20) of the lifting tool (20) against the inner surface, the outer surface, or both the inner and outer surfaces of the pipe section (3,4), is enabled to lift the pipe section (3,4) or pipe-string (2,3,4), and move to a rotary table (161) for joining of the pipe section (3,4) with the generally upright pipe string (2) located below.

74. A lifting system according to claim 69-71, wherein the lifting system further comprises a tube feeding machine for feeding of pipe section (3,4) to the lifting part (20) of the lifting tool.

75. A lifting system according to claim 74, wherein the lifting system comprises a manipulator arm (170) for moving the far end of the pipe section (3,4) from the tube feeding machine (180) to a vertical position over the generally upright pipe section or pipe-string (2).

76. A lifting system according to claim 72, wherein the rotation apparatus (80) comprises a clamping apparatus, or a first set of power tongs (81) which are arranged for retaining the pipe section or pipe string (2) in a fixed position, and a torque apparatus or a second set of power tongs (82) arranged for rotation of the lifting part (20) and pipe section (3,4) for joining with the pipe section or pipe string (2) by means of a torque or rotation motor.

77. A method for lifting of pipe sections for joining of pipe sections (3,4) to a pipe string (2), such as conductors, casings, risers or similar, for use in a bore hole or well (160) by means of a lifting system and a lifting tool according to the preceding claims 1-76, in which the method comprises the following steps:

- the pipe section (3,4) is brought to the start position in proximity to the lifting part (20) of the lifting tool (20);
- the lifting part (20) of the lifting tool grasps the end of the pipe section (3,4) which is or will become the upper end of the pipe section (3,4);
- the lifting part (20) is activated for engagement with at least one of the inner or outer surfaces of pipe section (3,4) by means of a hydraulic system (40);
- a drive unit, top drive or derrick crane (60) lifts the lifting tool with the pipe section (3,4) to the vertical or nearly vertical position over a generally upright pipe section or pipe-string (2) arranged below;
- the second, opposite end of the pipe section (3,4) is joined with the generally upright pipe section or pipe string (2) below, thus forming an extended resulting pipe string (2);
- the resulting pipe-string (2) is lowered and retained in place by means of a wedge system (power slip) (150) which is arranged for to retaining the pipe section or pipe string (2) in a drill floor;

- the resulting pipe-string (2) is released from the wedge system or power slip (150) such that it is suspended from the drive unit or top drive (60) and the lifting tool;
- the resulting pipe string (2) is lowered and again retained in place by the wedge system or power slip (150); and
- the lifting tool is released from the end of the resulting pipe string (2);

characterized in

- that the step of grasping the lifting part (20) of the lifting tool (20) involves that the lifting tool is arranged in an elevator apparatus (70), and that the lifting part (20) of the lifting tool is rotated about a generally horizontal axis in the elevator apparatus (70), by means a tilting arm (10) which in one end is fastened to the connection part (5) of the lifting tool and in the other end connected to a lifting cylinder (61) mounted on the drive unit or top drive (60), from a generally vertical initial position to an engagement position with the pipe section (3,4) which is arranged in a generally horizontal or nearly horizontal position.

78. A method according to claim 77, wherein the method further comprises the following step:

- the connection part (5) of the lifting tool is removably arranged in the elevator apparatus (70), preferably in an upper part or lifting shoulder (13) on the piston rod (47), prior to the pipe section (3,4) being brought to the lifting tool.

79. A method according to claim 77, where the method also comprises the following step:

- the pipe section (3,4) is moved forward to the lifting tool lifting part by means of a tube feeding machine and into engagement with the lifting part (20) of the lifting tool (20) prior to activating the lifting part (20) of the lifting tool (20).

80. A method according to claim 79, wherein the method also comprises the following step:

- as the pipe section (3,4) is moved forward on the tube feeding machine, the opposite end of the pipe section (3,4) is moved into position above the generally upright pipe section or pipe string (2) by a manipulator arm (170); and
- the lifting tool and the pipe section (3,4) is lowered to the generally upright pipe section or pipe string (2) arranged below for joining with the pipe section or pipe string (2).

81. A method according to claim 77, wherein the method further comprises the following step:

- joining of the pipe section (3,4) and the pipe string (2) is achieved by screwing the opposite, lower end of the pipe section (3,4) into a threaded section of the upper end of the generally upright pipe section or pipe string (2) through rotation of the lifting part (20) of the lifting tool with the pipe section (3,4) about the central axis of the lifting tool by means of a rotation system (80).

82. A method according to claim 77, wherein the method further comprises the following step:

- upon activation of the lifting tool, a wedge system (24,29) in the lifting part (20) of the lifting tool is engaged against one or both of the inner and outer diameters of the pipe section (3,4) by means of a piston hydraulic system (40).

83. A method according to claim 82, wherein the method further comprises the following step:

- upon activation of the lifting tool, an entry cone (140) or expanding packing (140) is forced against inner wall of the pipe section (3,4).

84. A method according to claim 79, wherein the method also comprises the following step:

- screwing of a lifting nipple (32) into a threaded section of the upper or following upper end of the pipe section (3,4), preferably by means of a nipple rotation system (90).

85. A method according to claim 82, wherein the method also comprises the following step:

- upon release of the lifting tool from the pipe section or pipe string (2), the wedge system (24,29) in the lifting part (20) of the lifting tool is disengaged from the end of the pipe section or pipe string (2) by means of a hydraulic system (40), such that the lifting tool may be moveed to the finish or standby position.

86. A method according to claim 84, wherein the method also comprises the following step:

- upon release of the lifting tool from the section or pipe string (2), the lifting nipple (32) is unscrewed from the threaded end of the pipe-string (2), preferably by means of a nipple rotation system (90), or manually by means of a manual release system for the lifting nipple (32), and thereafter the wedge system (24,29) is released from the end of the pipe section or pipe string (2).

87. A method according to claim 77, wherein the method also comprises the following step:

- progress of entering the pipe section (3,4) into the lifting part (20) is monitored by a sensor system, preferably with one or more independent sensors (14,15), each being connected to a limit switch, which serves to stop the movement of the pipe section (3,4) at the proper moment for avoiding damage to the the pipe section, and for indicating proper centering of the lifting part (20) of the lifting tool with respect to the end of the pipe section (3,4) to be engaged by the lifting tool.

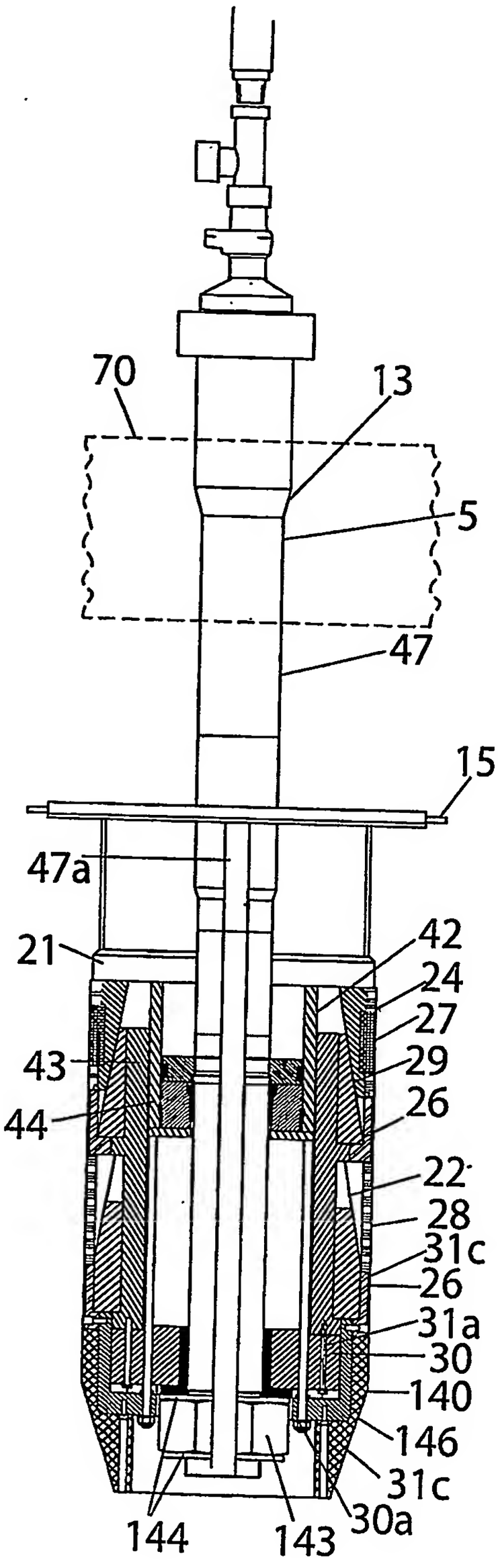

70
13
5
47
15
47a
21
42
24
27
43
29
44
26
22
28
31c
26
31a
30
140
146
31c
30a
144
143

Fig. 1a

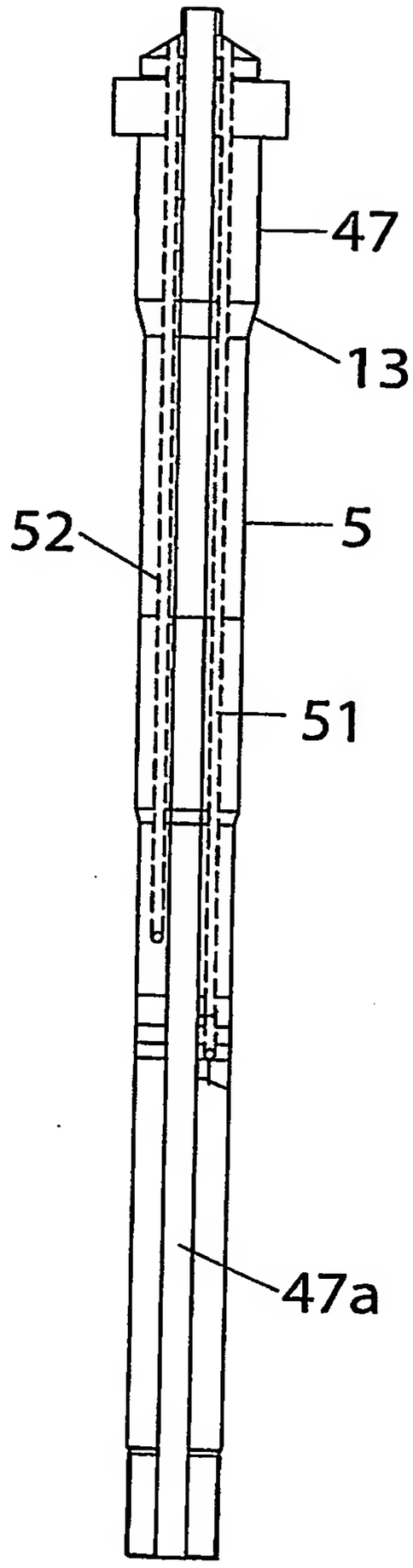

47
13
52
5
51
47a

Fig. 1b

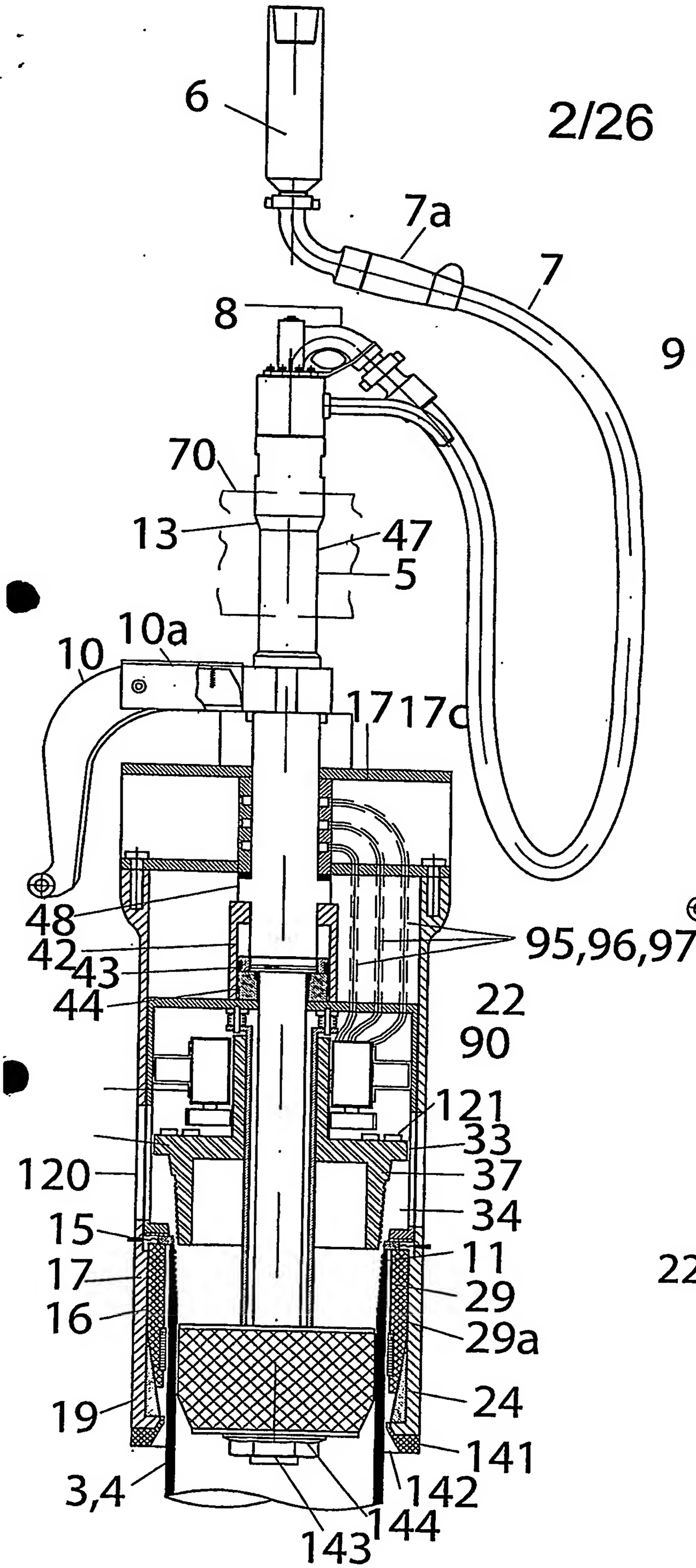


Fig. 2 a

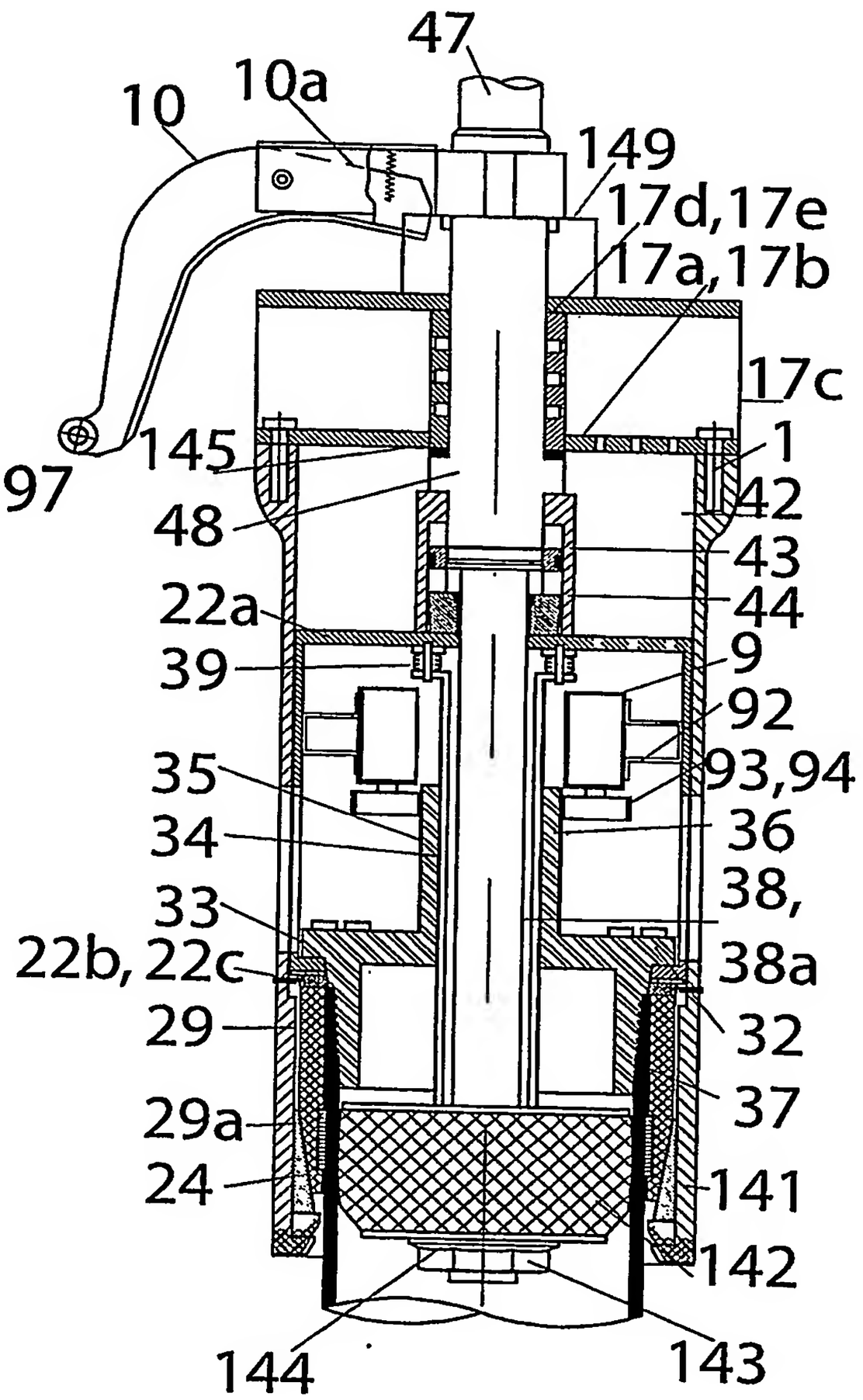
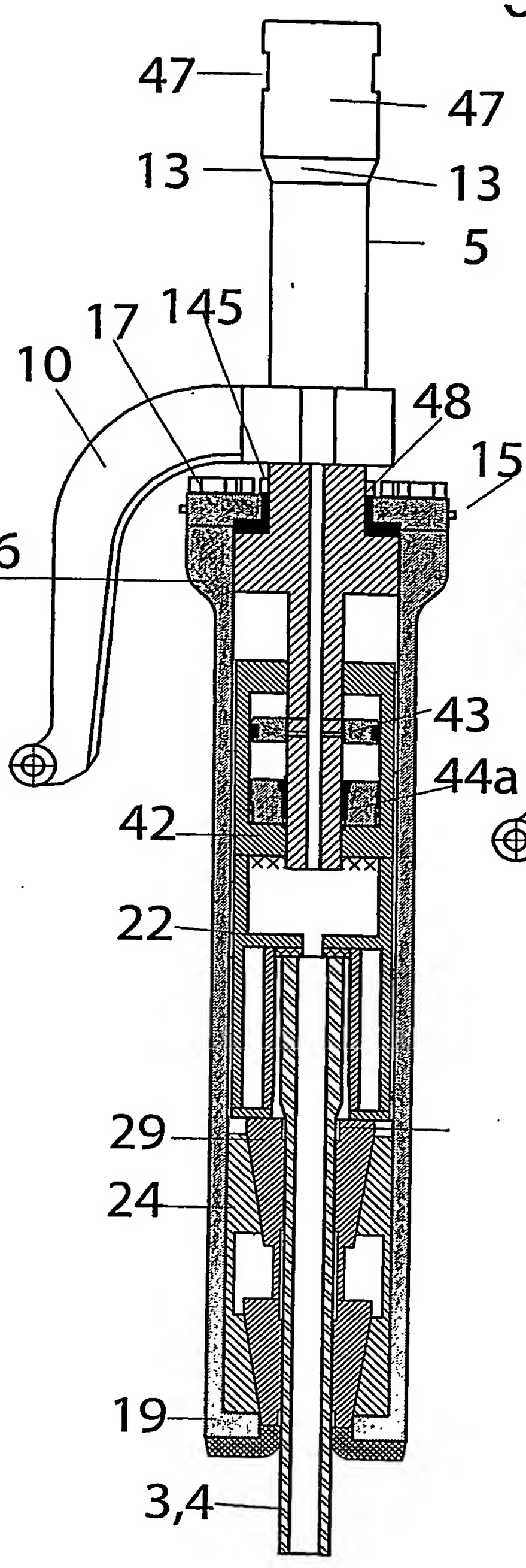


Fig. 2 b

AMENDED SHEET


47
47
13
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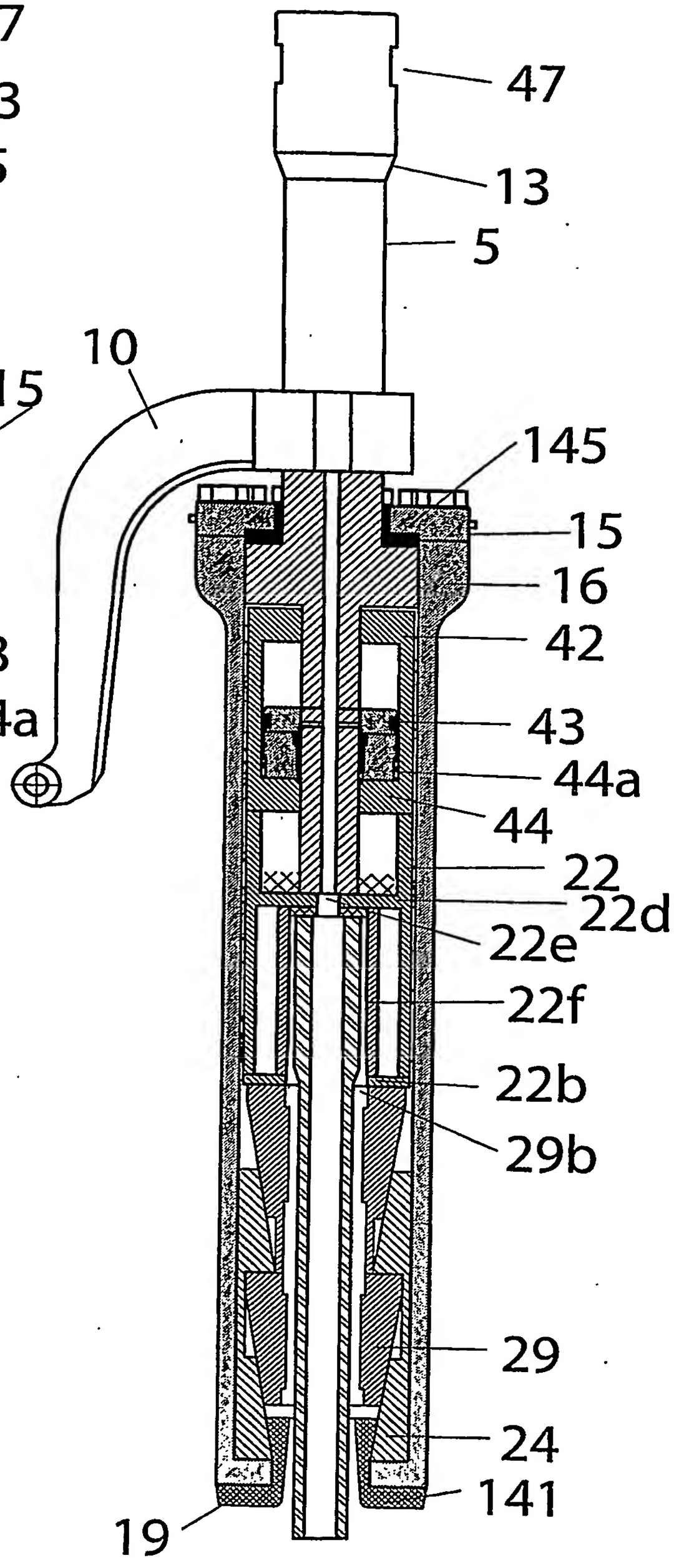
17
145
10
48
15
16
43
44a
42
22
29
24
19
3,4

Fig. 3a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145
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44a
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22e
22f
22b
29b
29
24
141
19

Fig. 3b

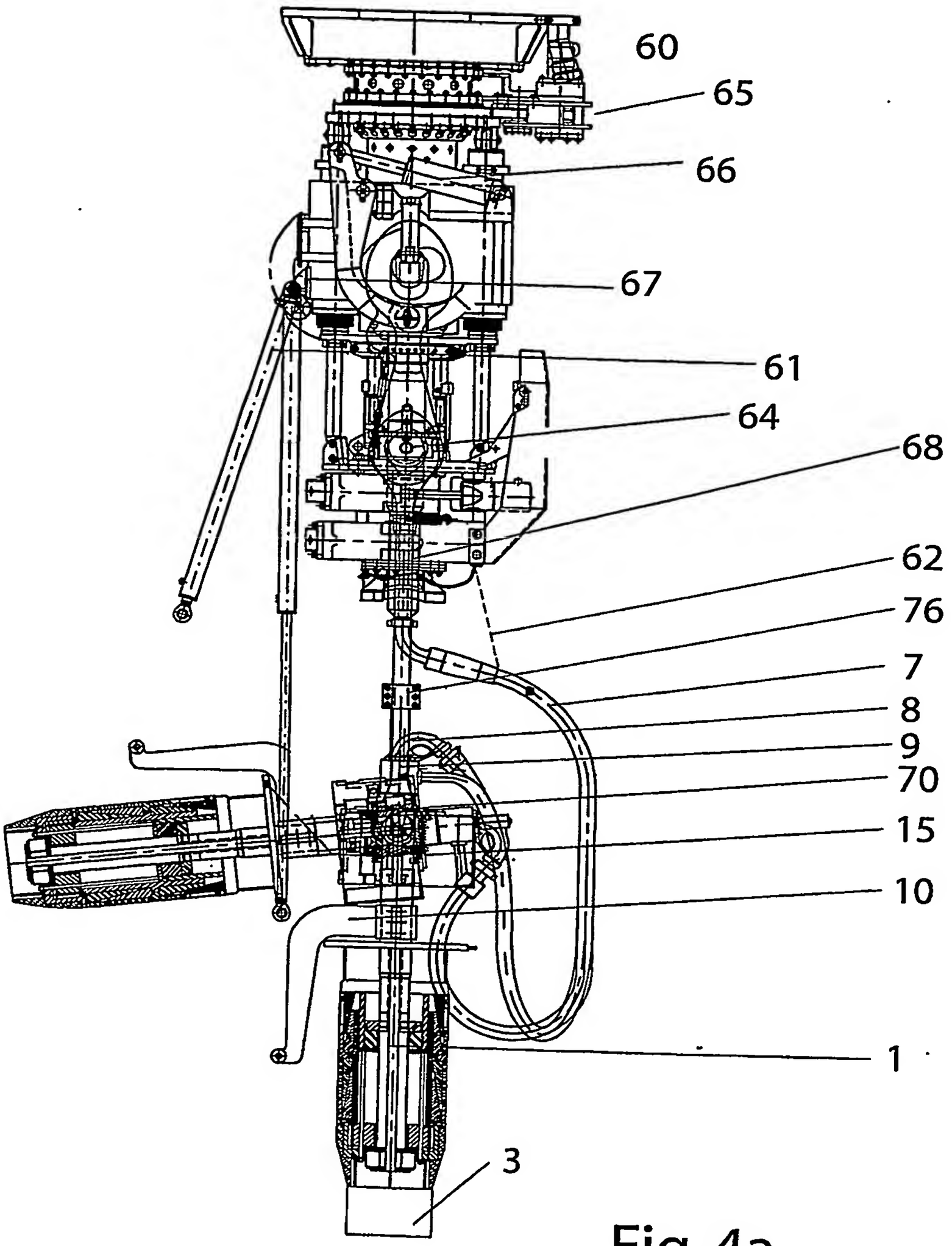

Fig. 4a

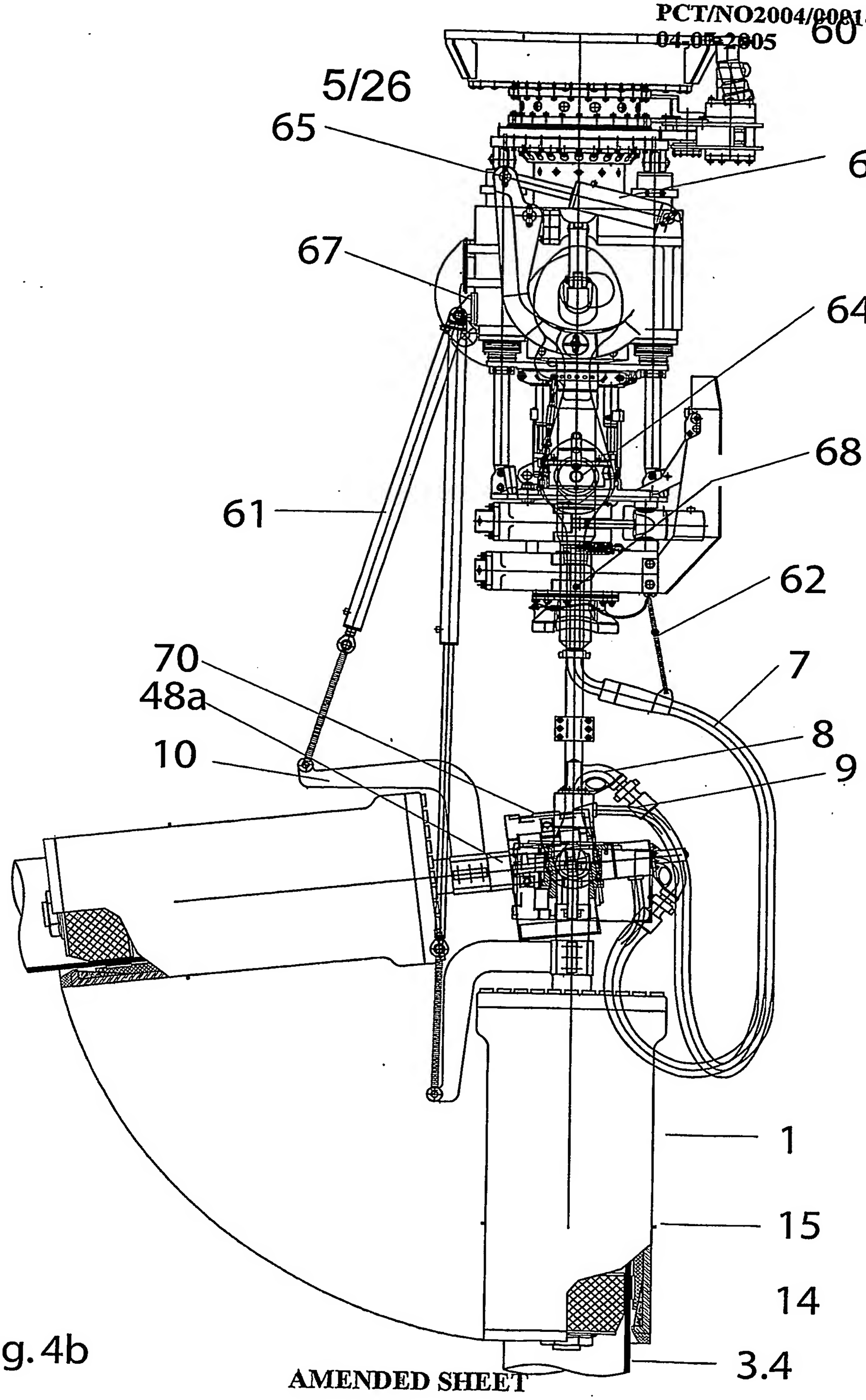

Fig. 4b

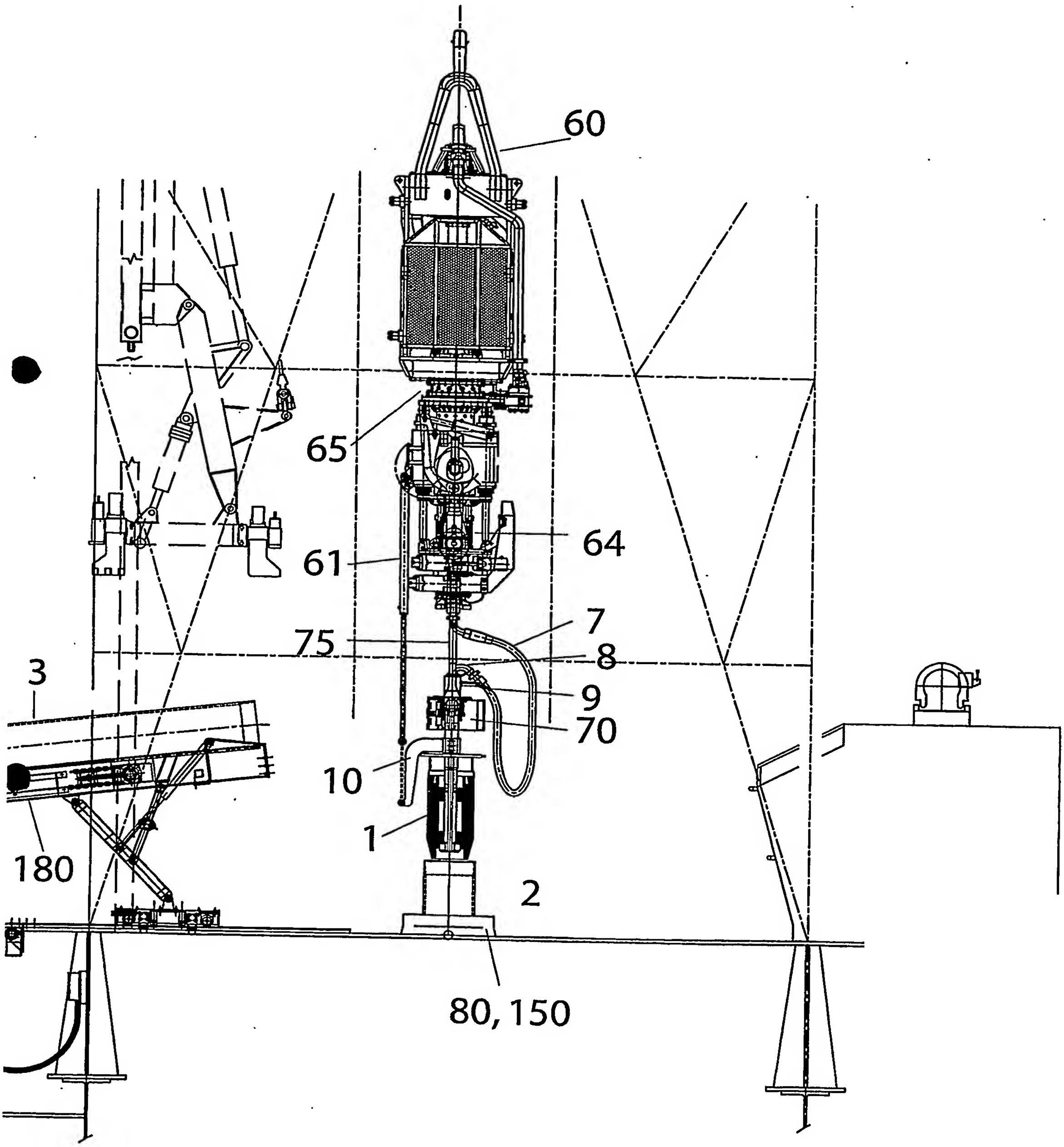

Fig. 5a

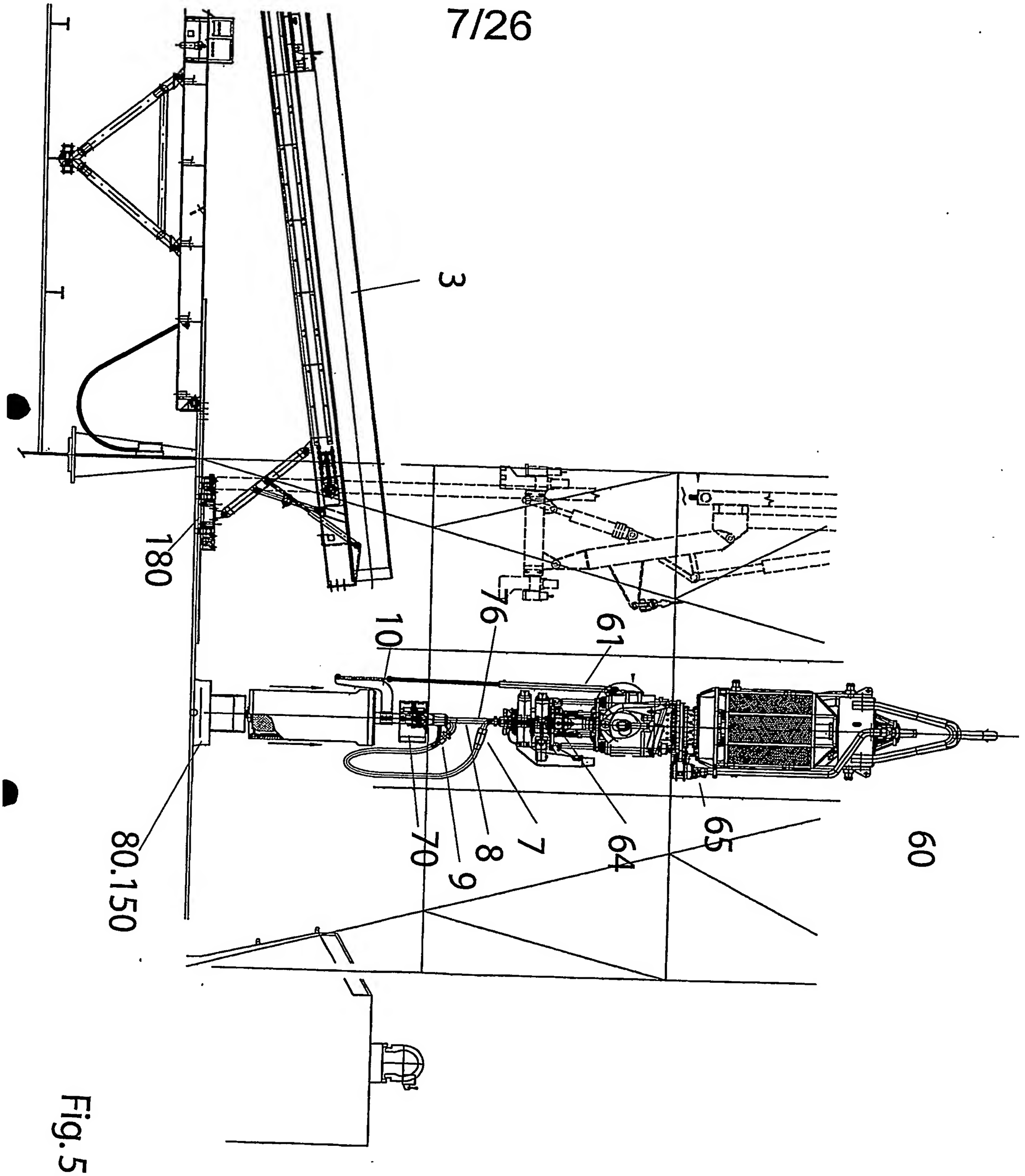

Fig.5b

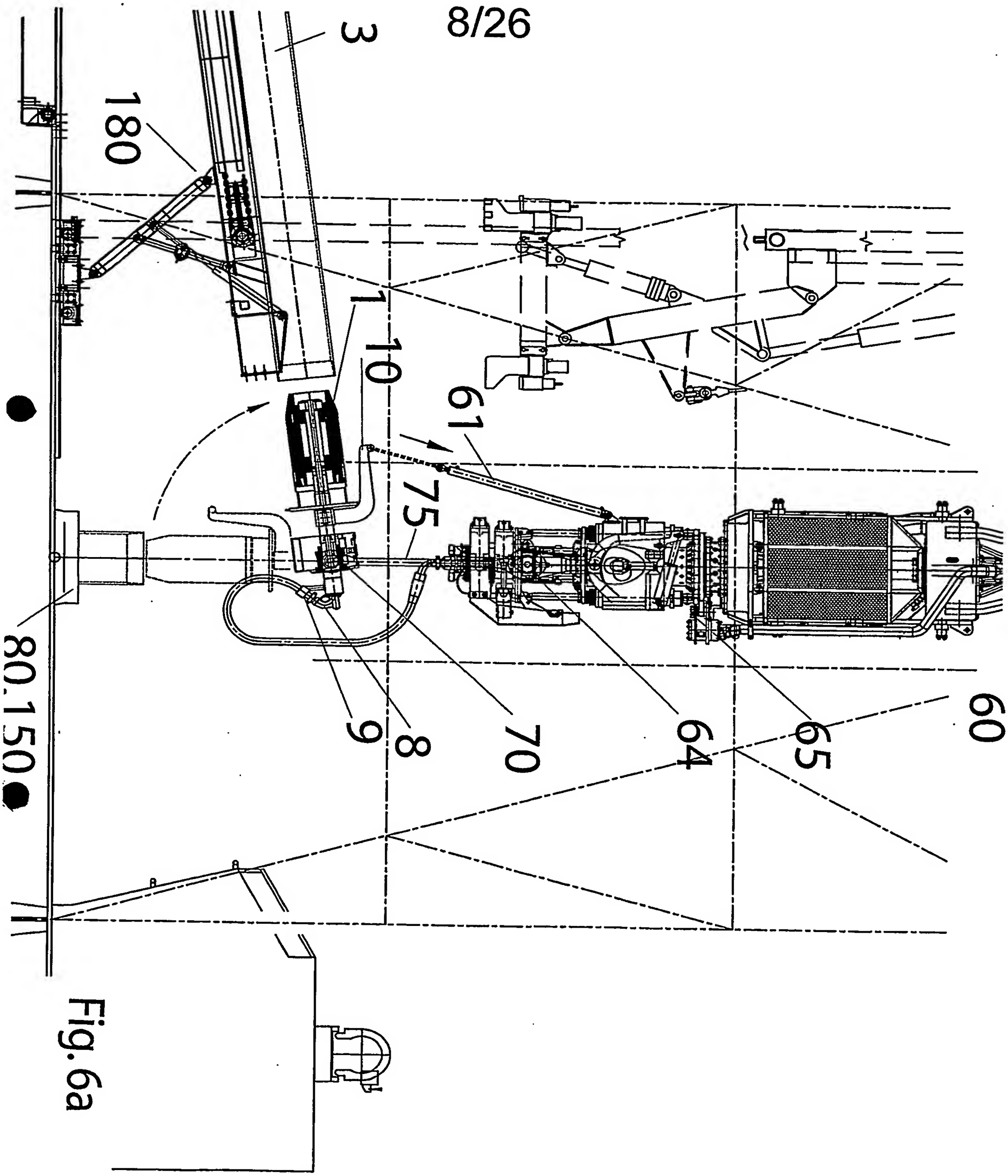

Fig.6a

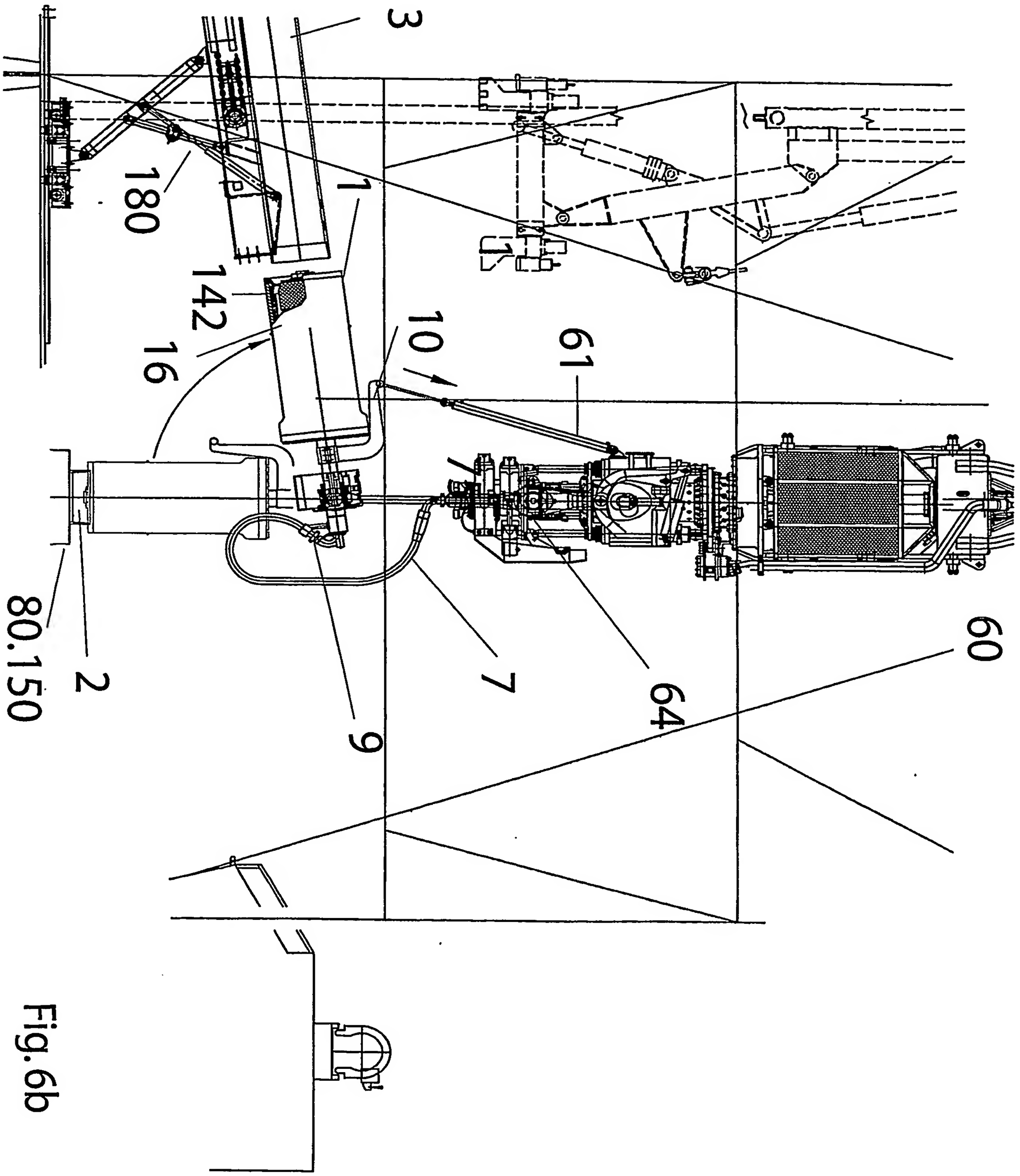

Fig.6b

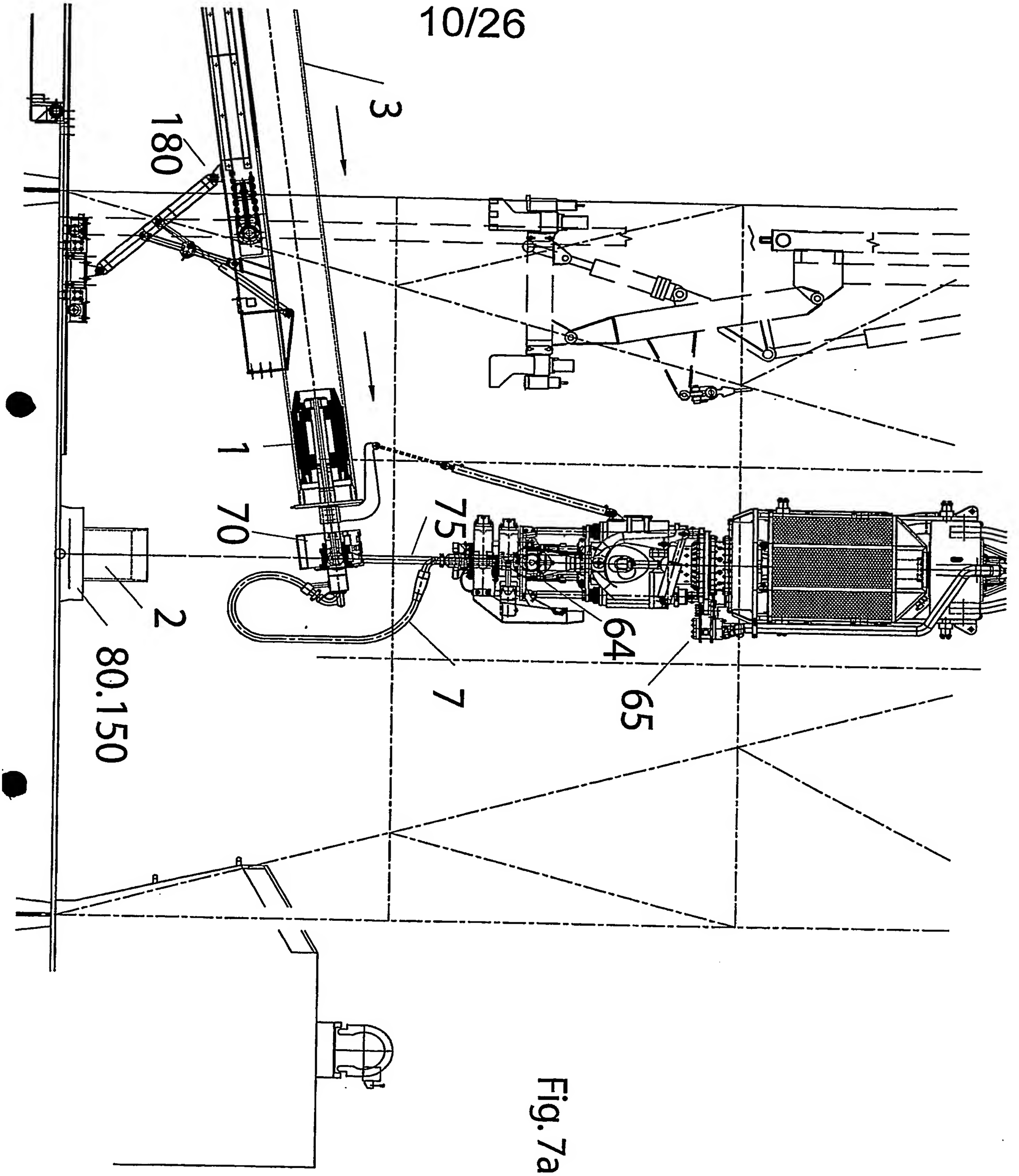

Fig.7a

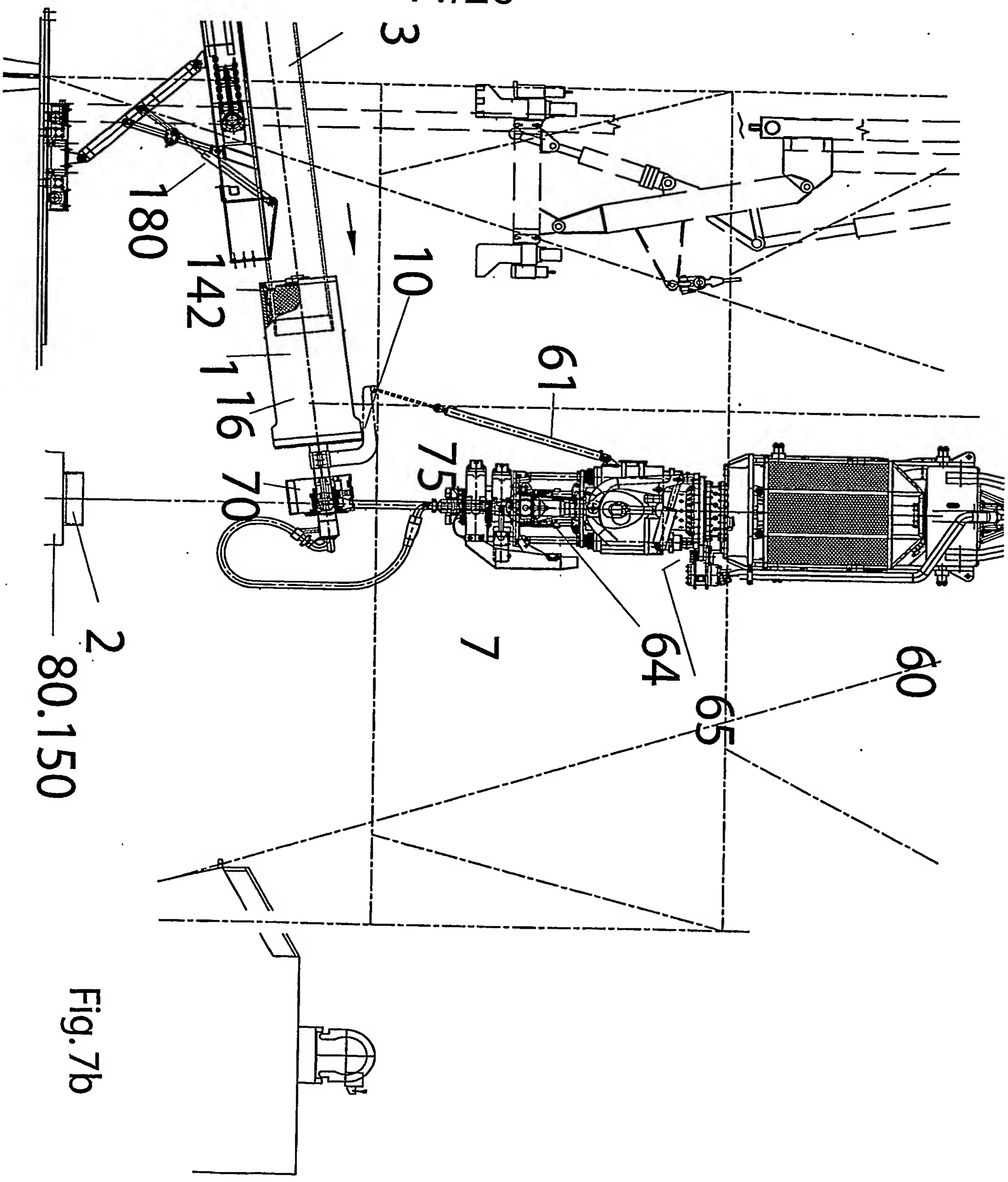

Fig.7b

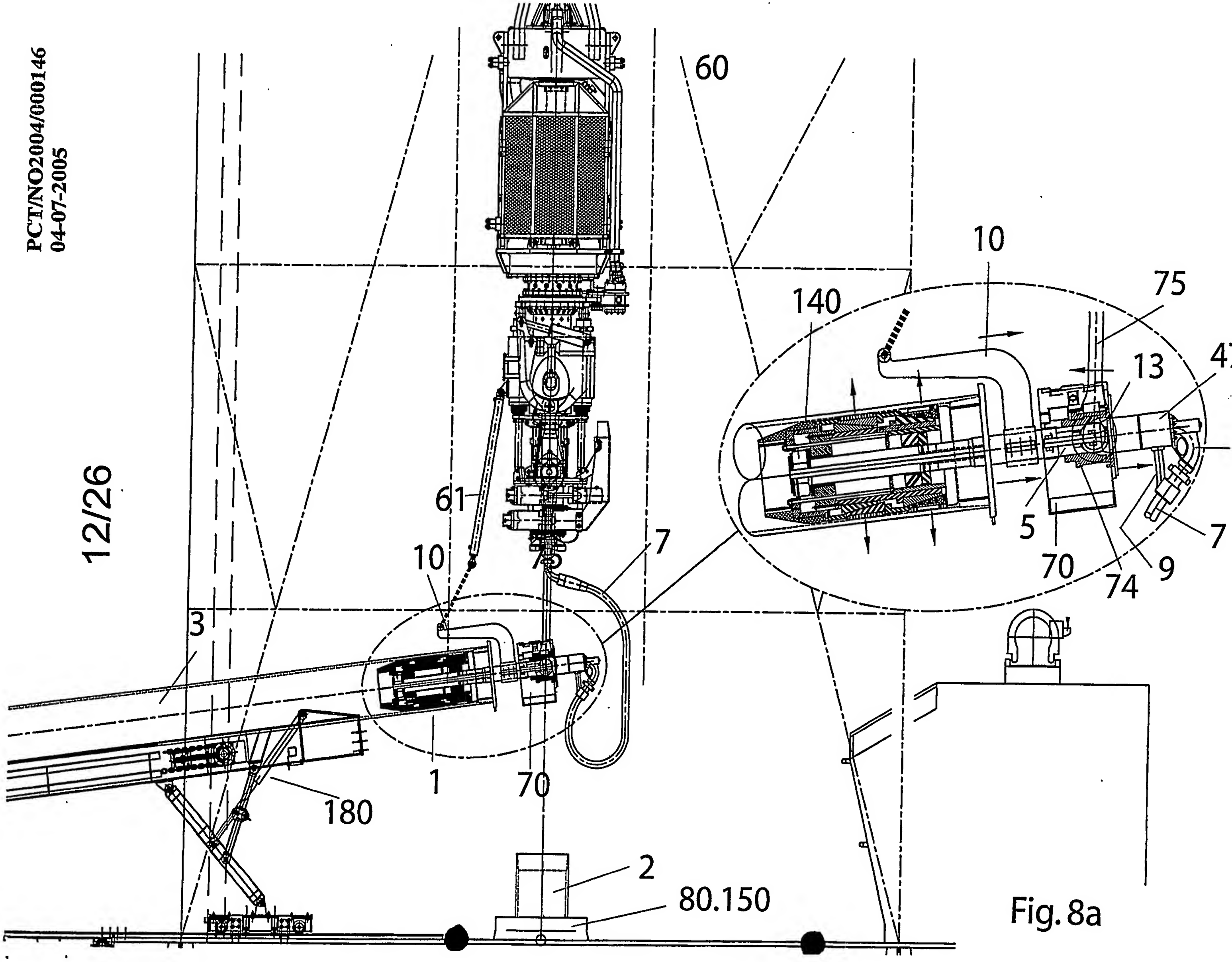

Fig. 8a

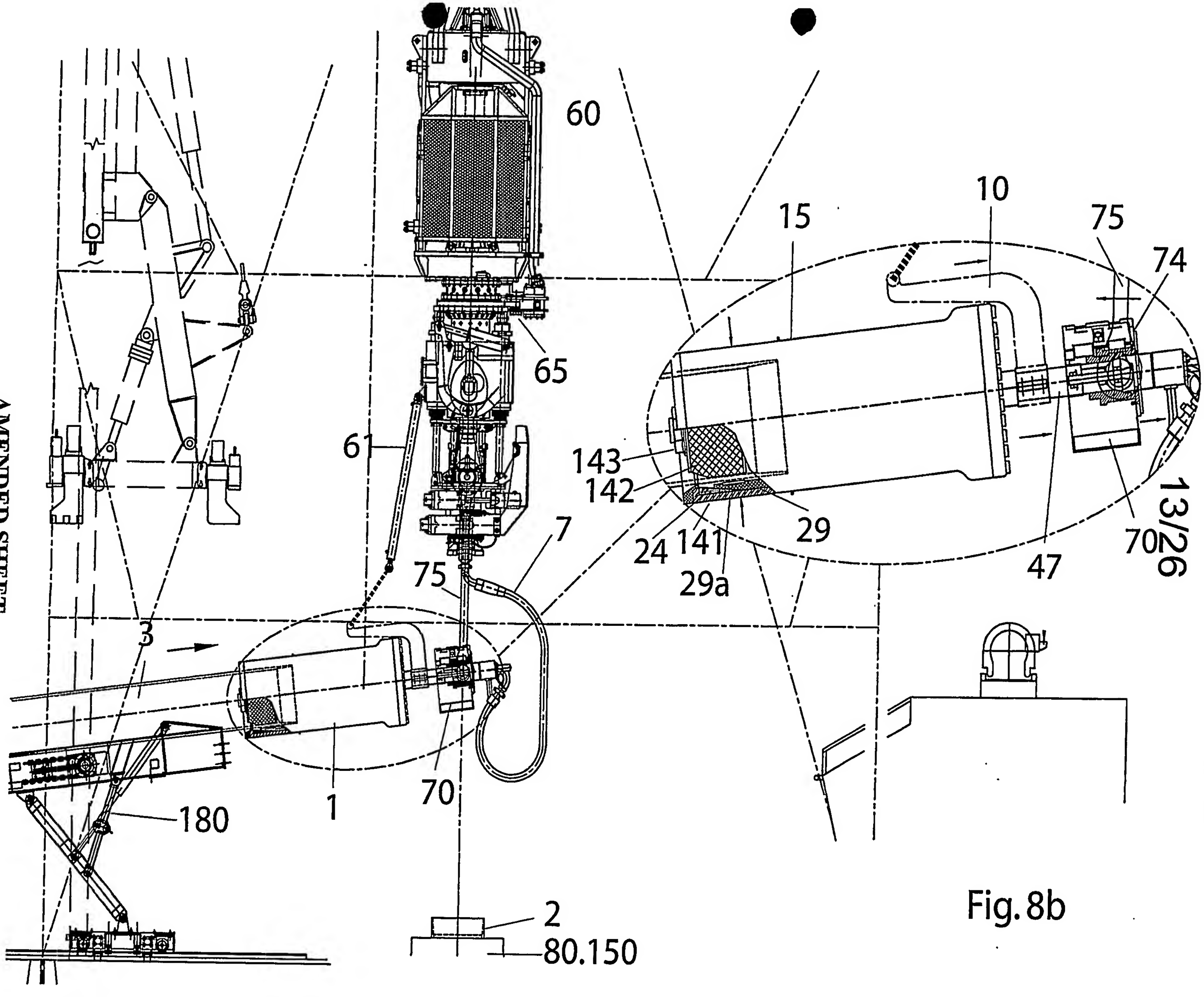

Fig. 8b

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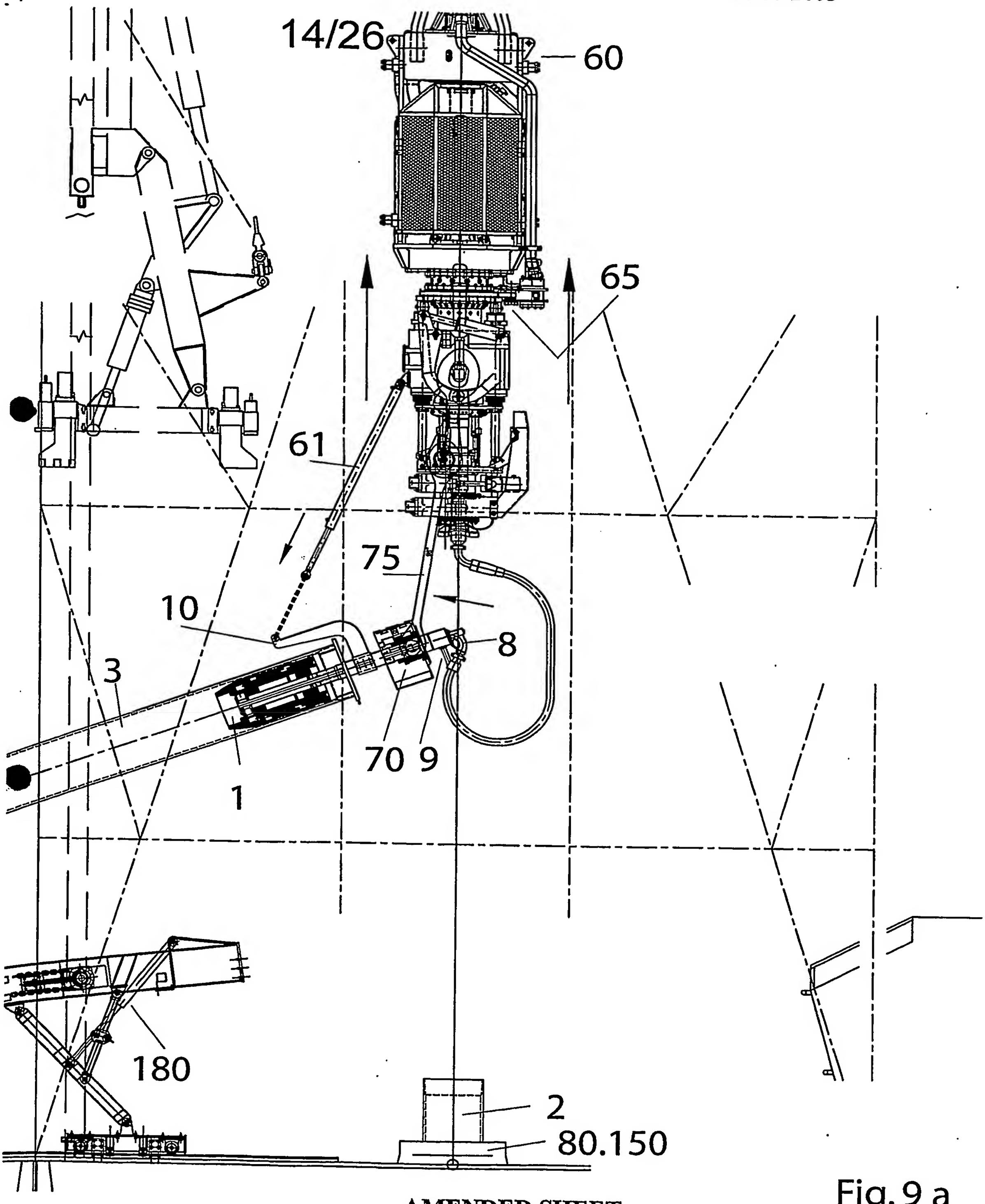

Fig. 9 a

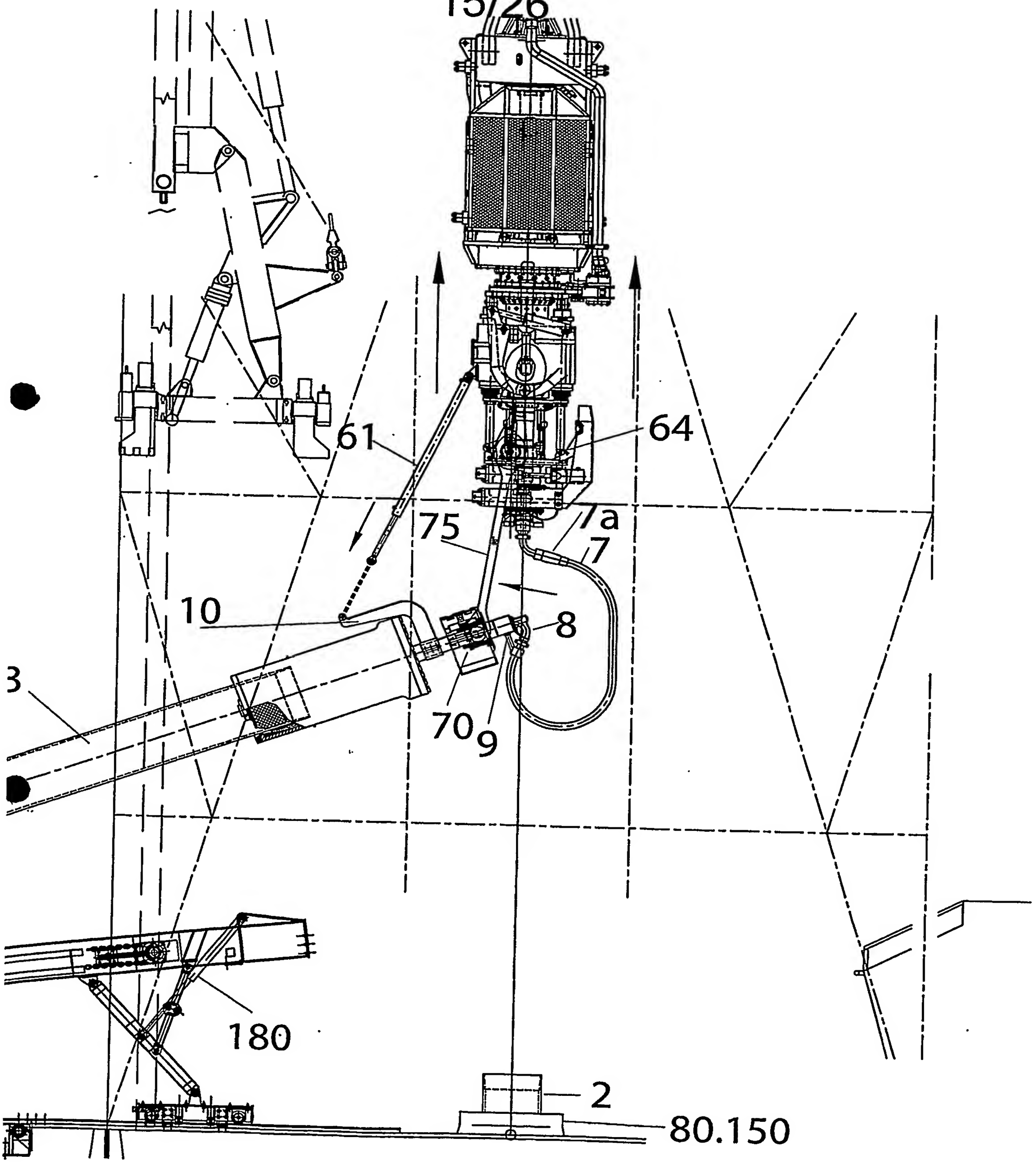

Fig. 9b

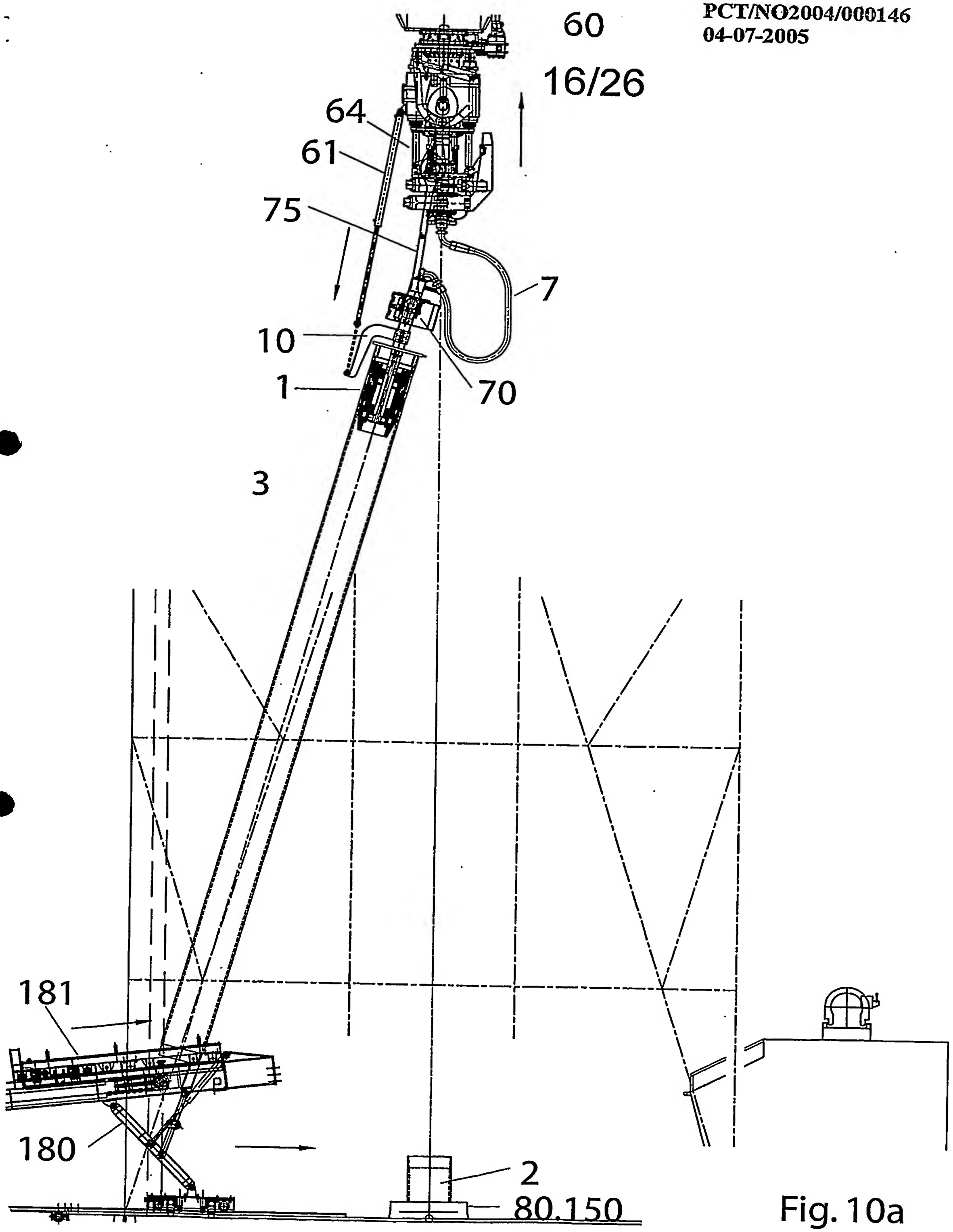

Fig. 10a

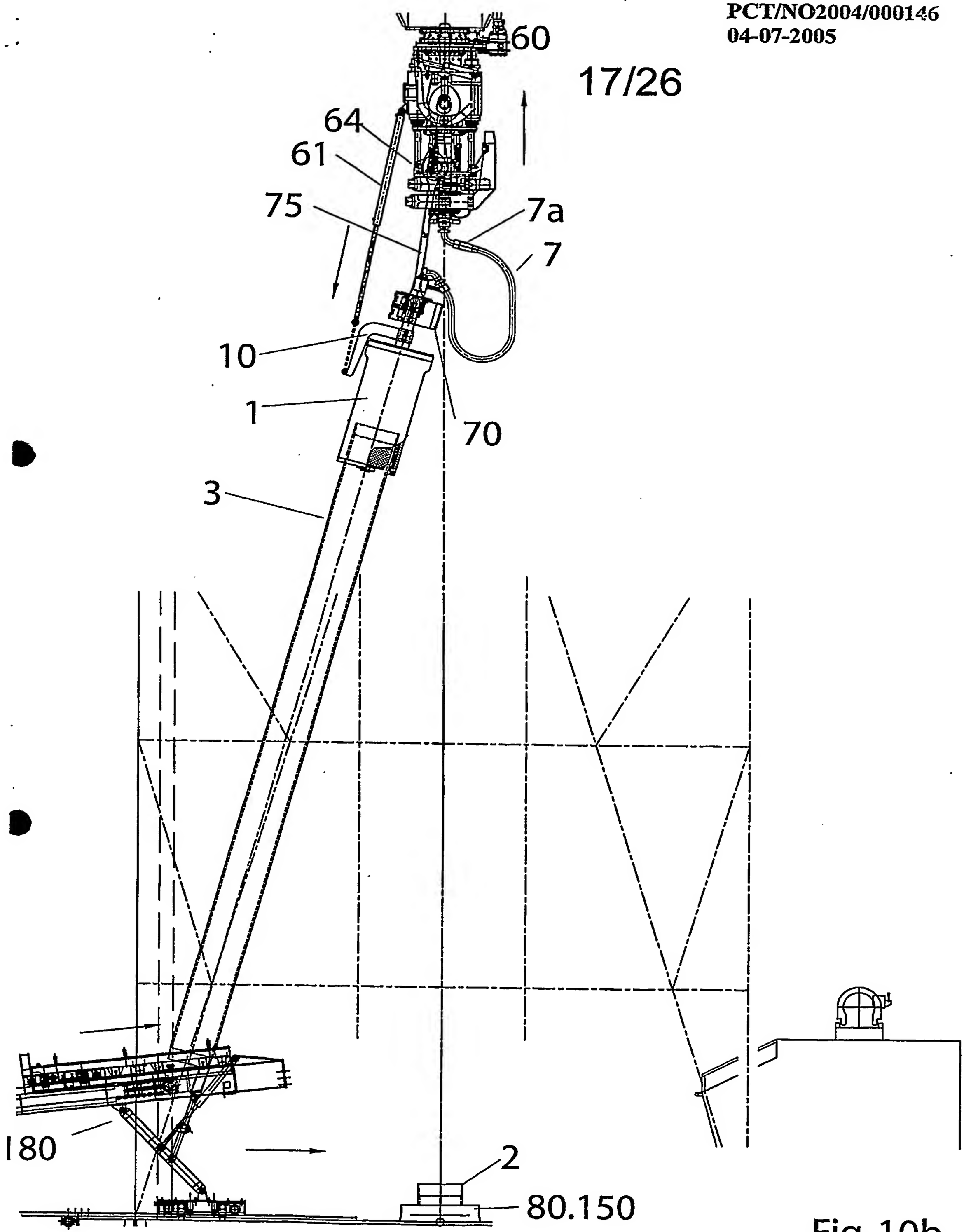

Fig. 10b

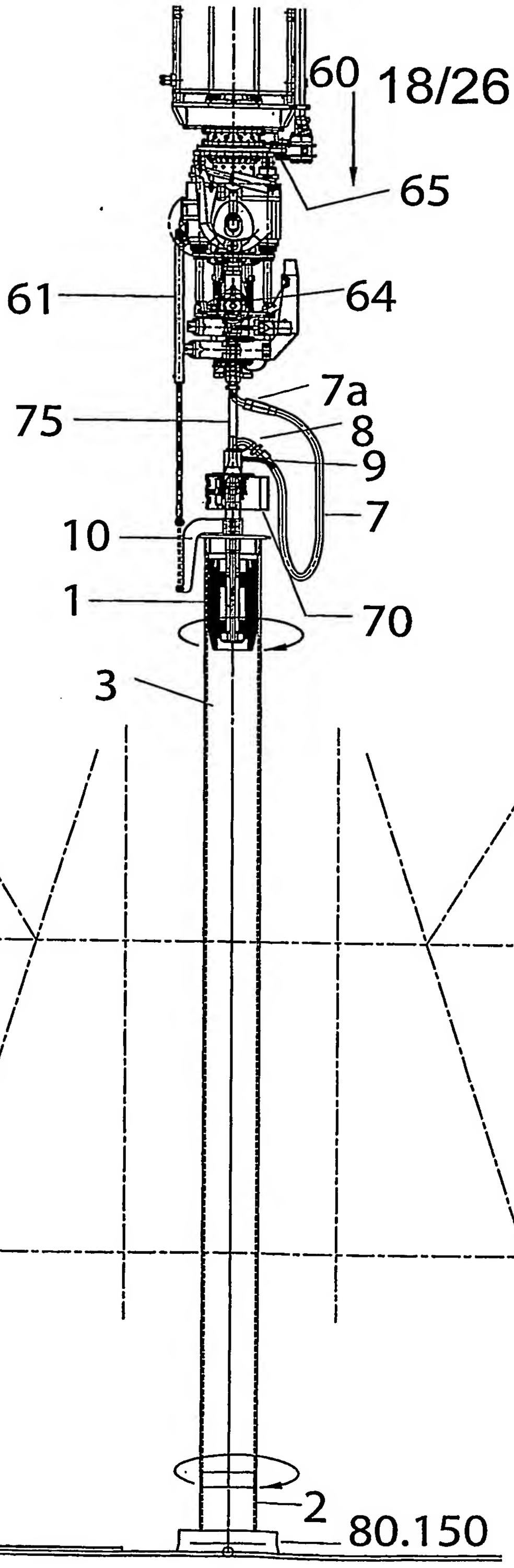

Fig. 11a

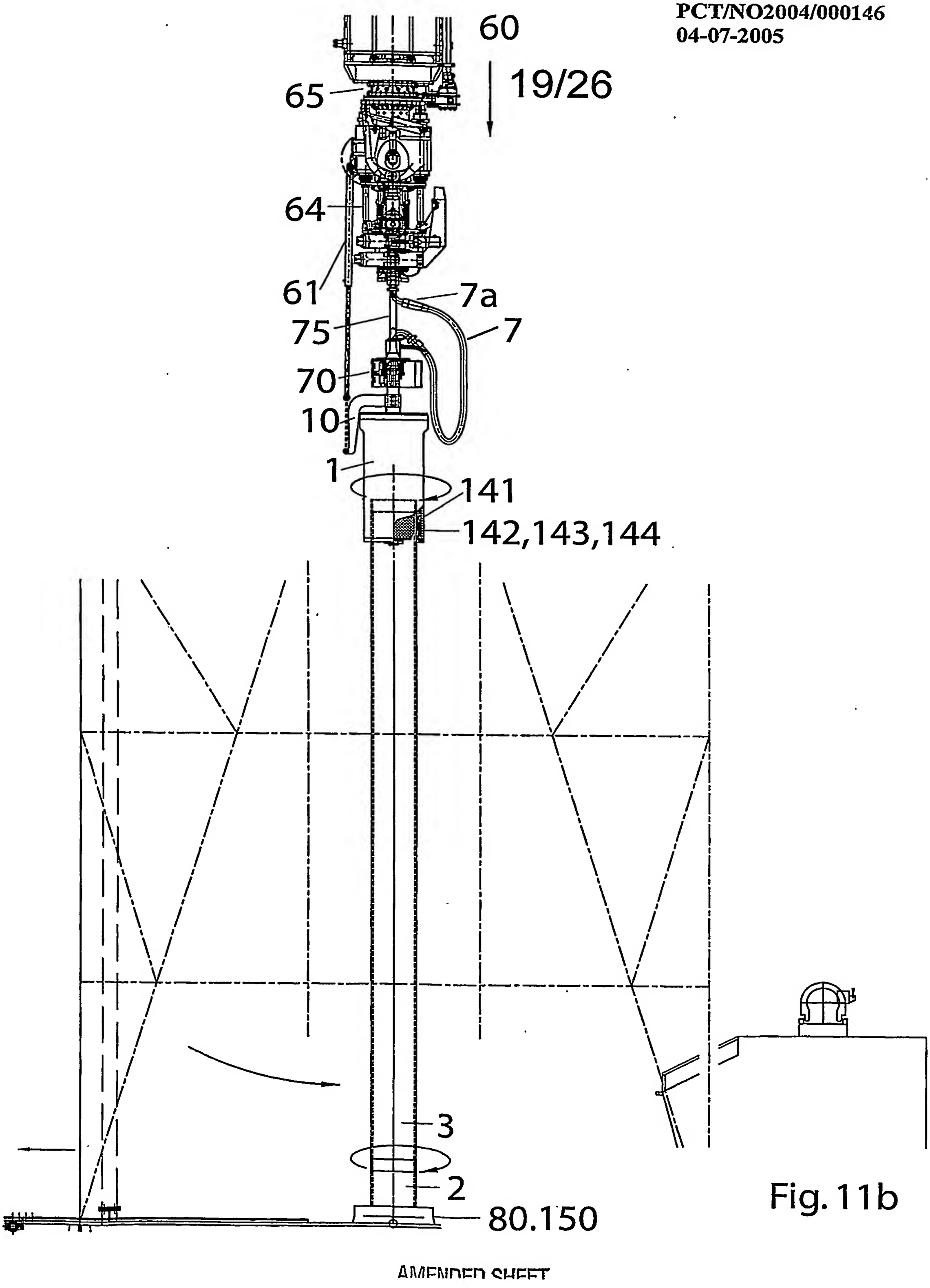

Fig. 11b

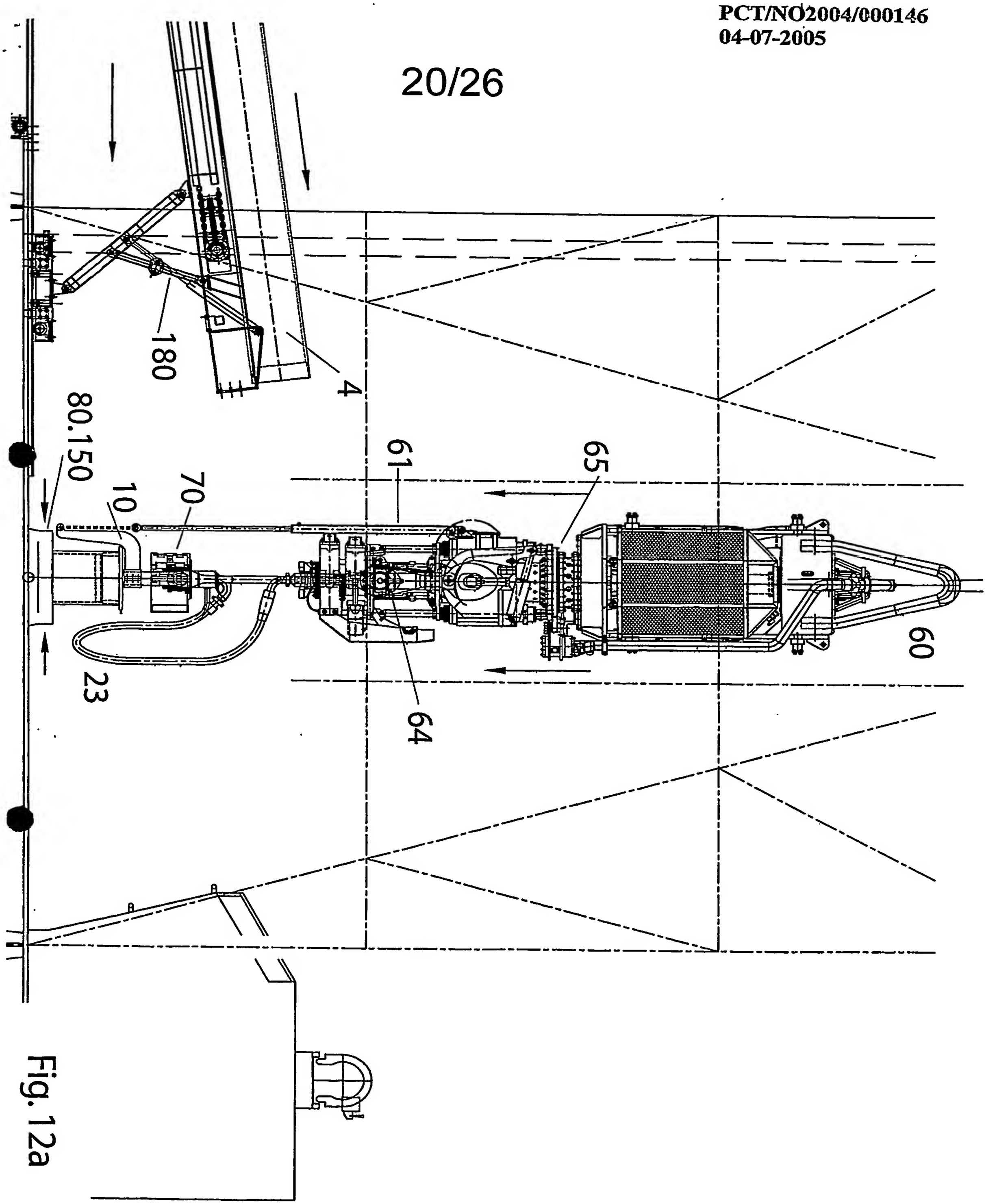

Fig. 12a

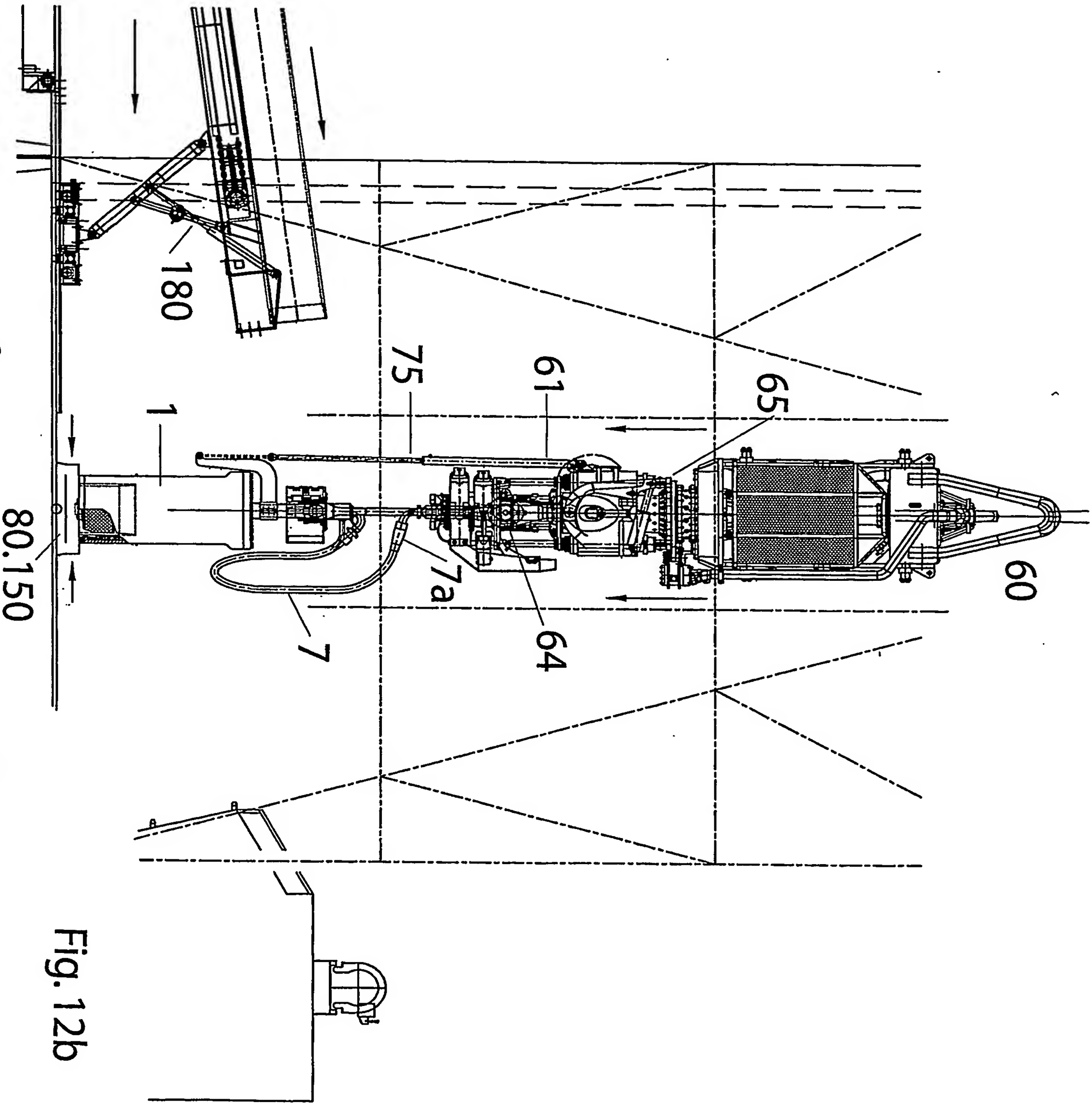

Fig. 12b

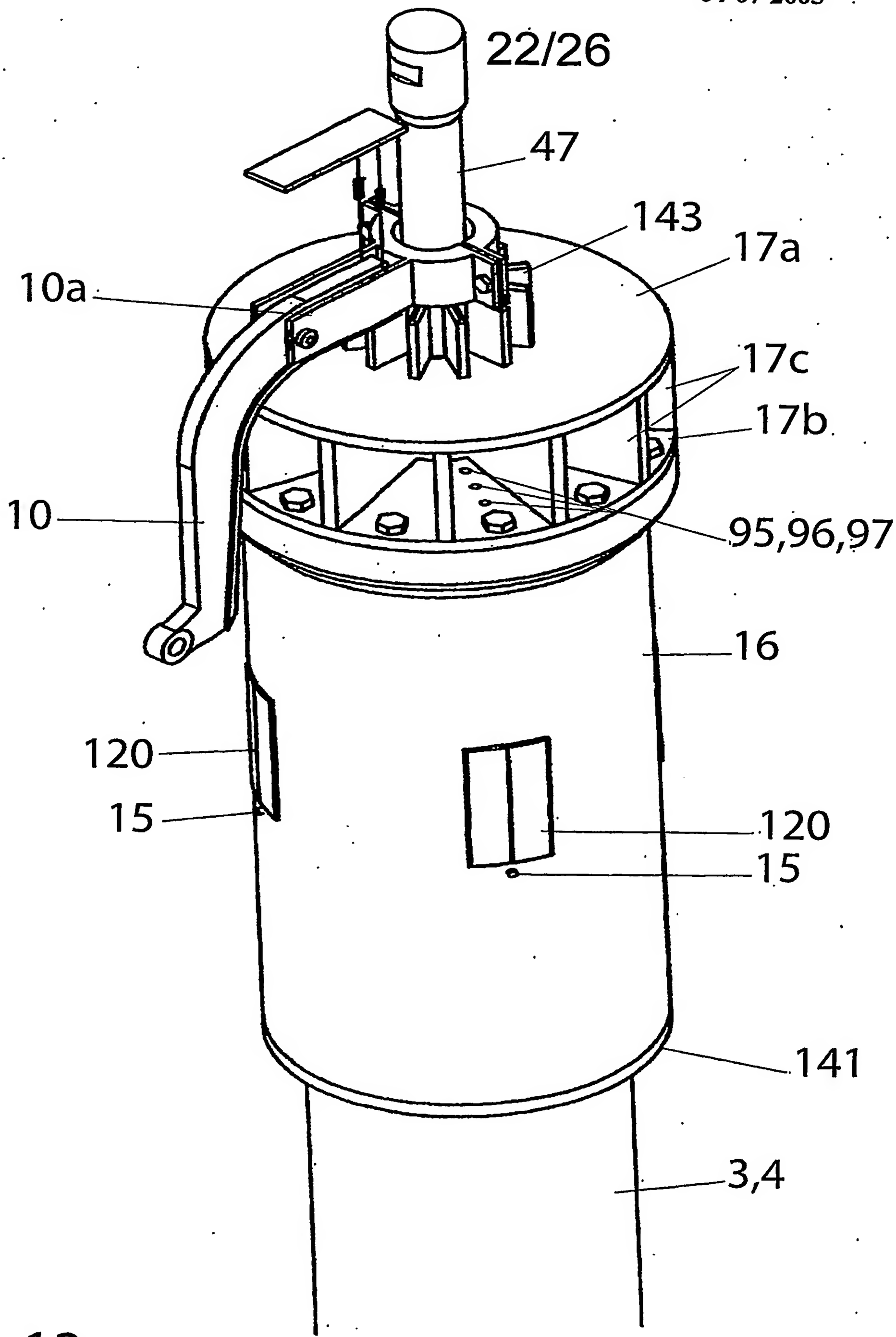

Fig. 13

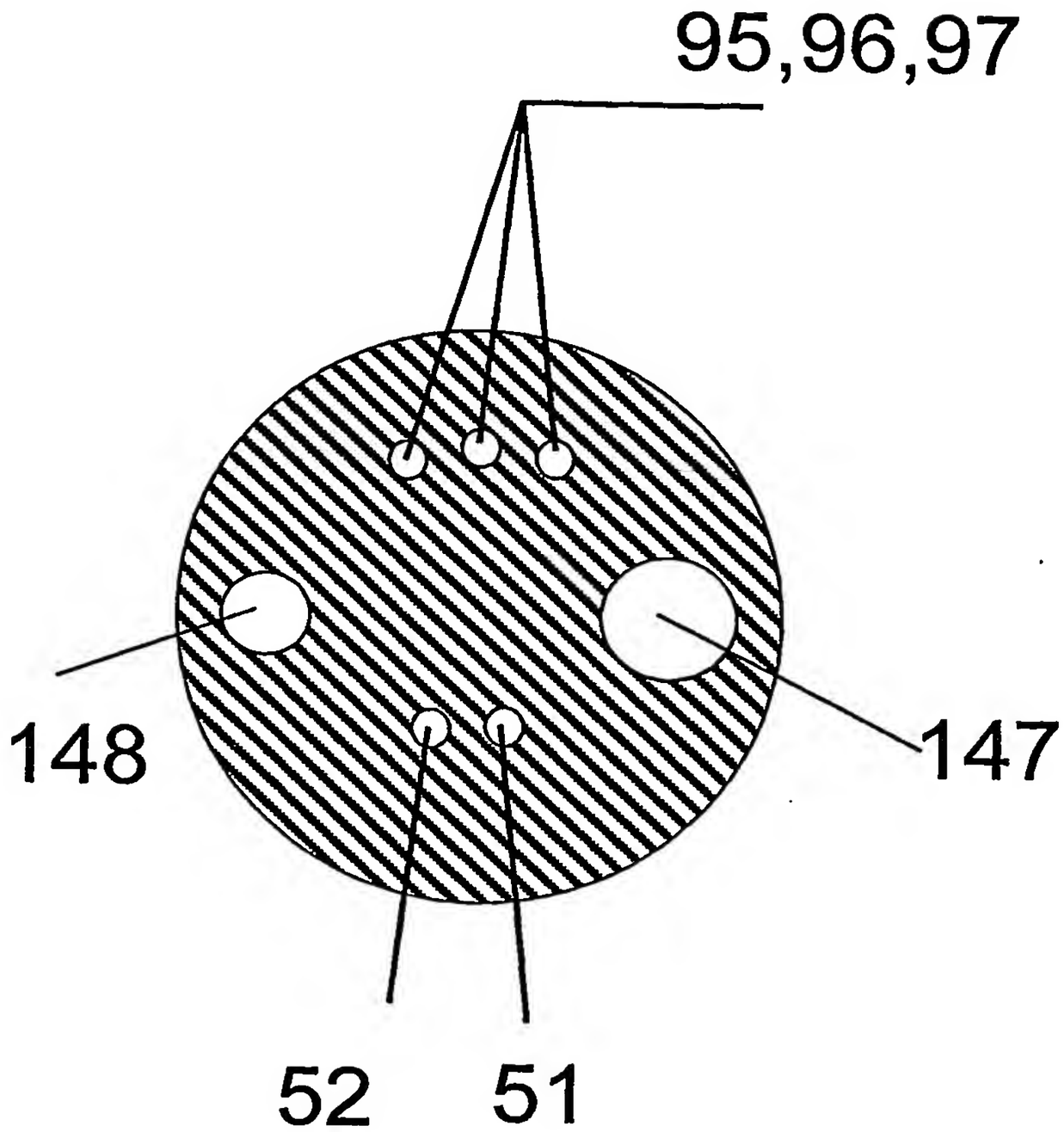

Fig. 14

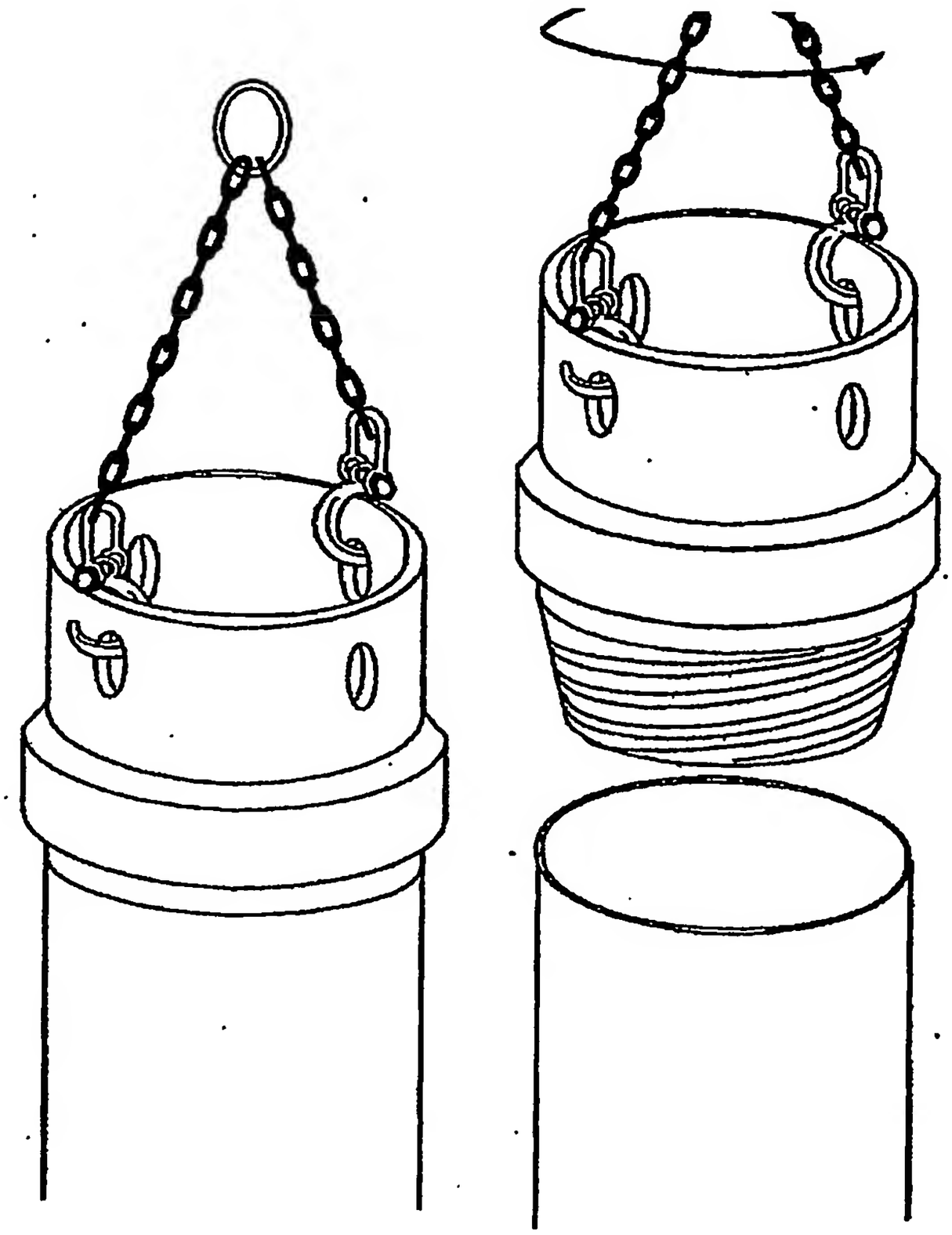

Fig. 15

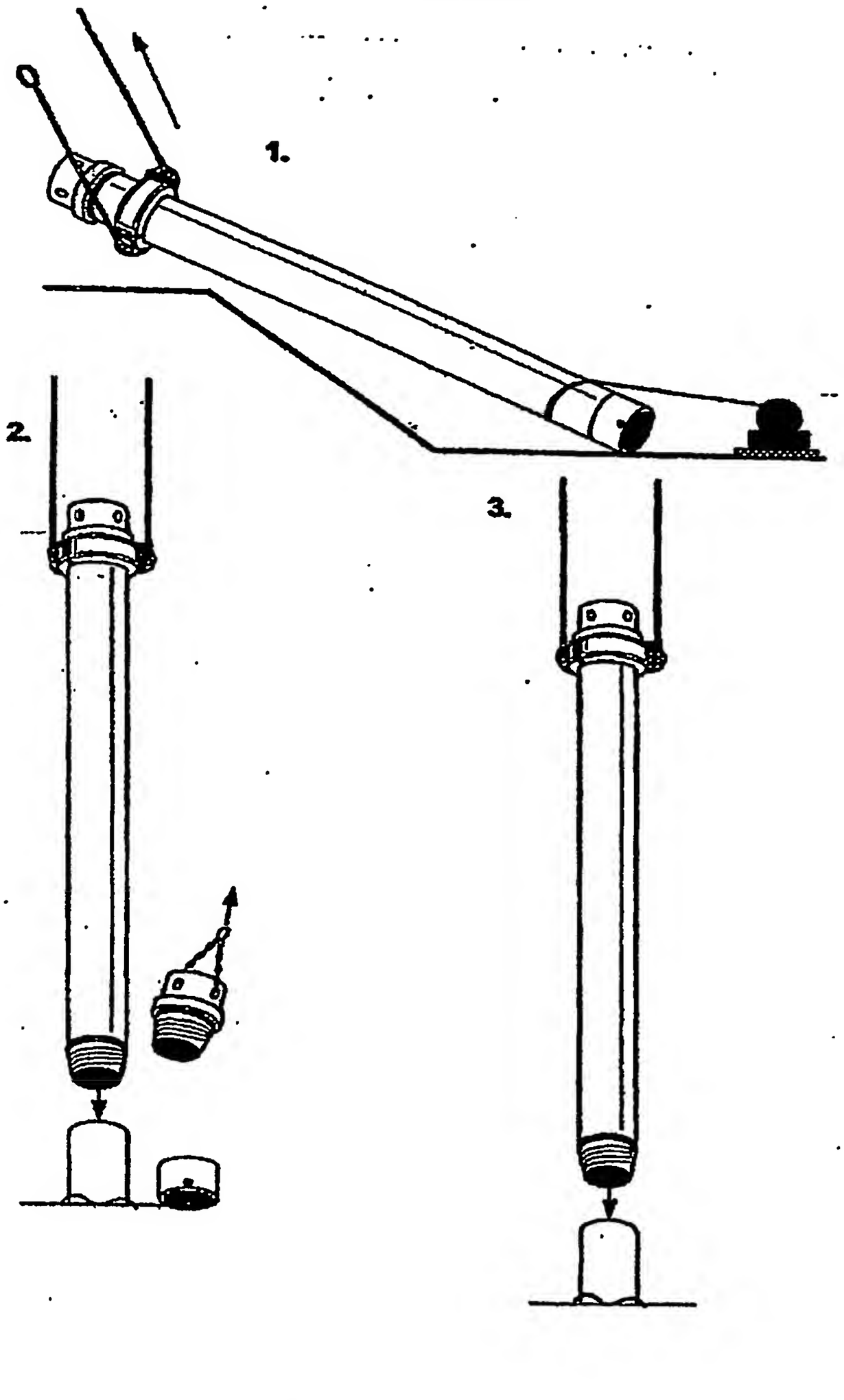

Fig. 16

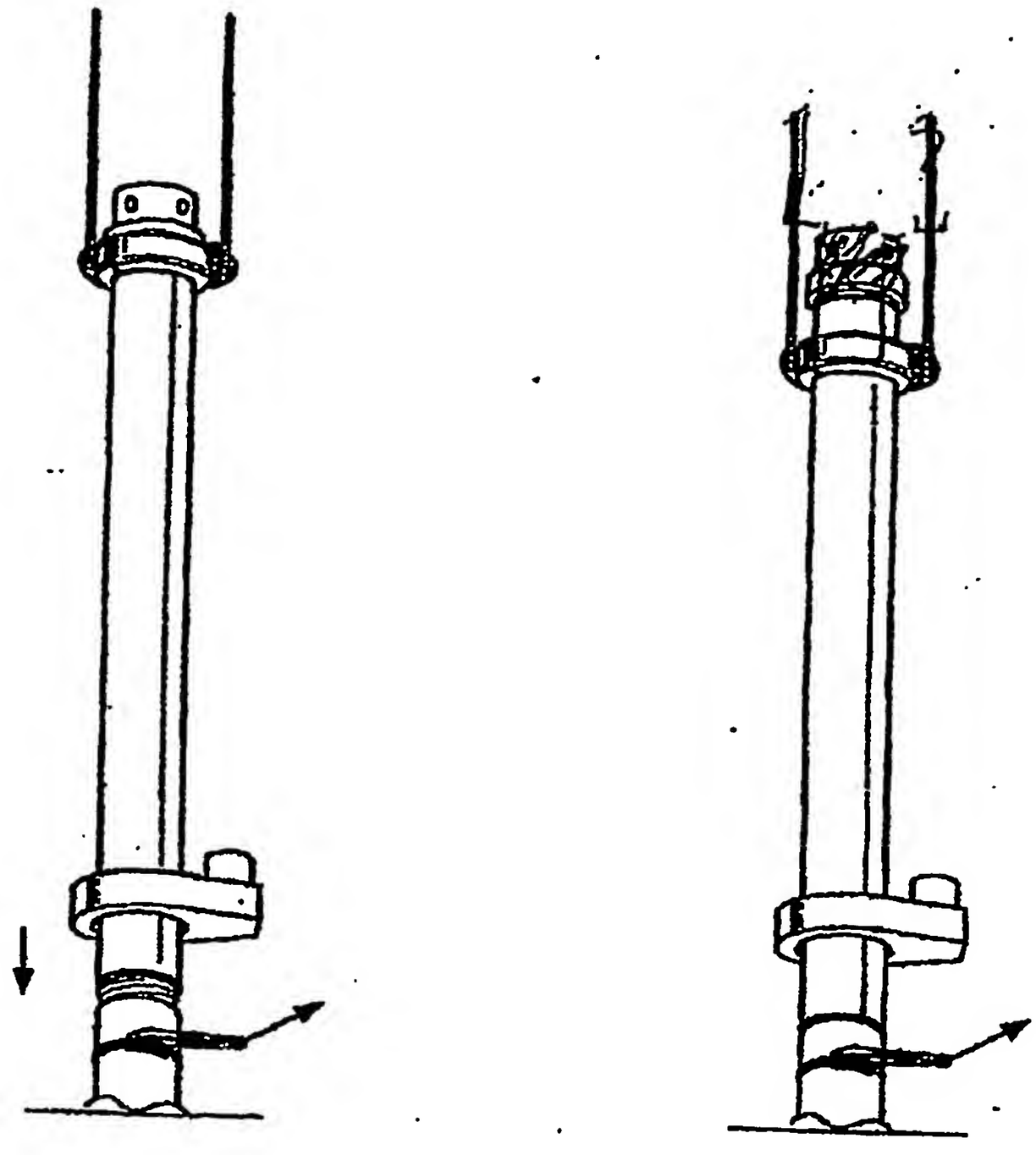

Fig. 17